Engineering Library

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The Engineer.

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VOL. CXLIV.—No. 3736] LONDON: FRIDAY EVENING, AUGUST 19, 1927 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
1. ONE OXY-ACETYLENE CUTTING PLANT.
2. ONE NOTCHING MACHINE, ONE CROPPING MACHINE, and TWO GUILLOTINE SHEARS.
3. TEN ELECTRIC RIVET HEATERS.
4. ONE HYDRAULIC PRESS and EIGHT RIVETERS, for 5-8in. and 1in. diameter rivets, with 4-ton jib type cranes.
5. 215¼ Tons SPRING STEEL.
6. About 114 Tons of STEEL FISH-BOLTS, with nuts.
7. 1384 STEEL SUPERHEATER FLUE TUBES.
8. 120,078ft. of MILD STEEL TUBULAR POINT RODDING.
9. 33 SLUICE GATES.
10. ONE BOGIE DYNAMOMETER CAR complete.
Tenders due on the 2nd September, 1927, for Nos. 1 to 6; on the 6th September, 1927, for Nos. 7 and 8; on the 14th September, 1927, for No. 9; and on the 18th October, 1927, for No. 10.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which will not be returned. 6295

Assistant Engineers (14) REQUIRED for the PUBLIC WORKS DEPARTMENT of the FEDERATED MALAY STATES for four years' service, after which subject to satisfactory service the officers appointed will be eligible for confirmation in the permanent and pensionable establishment. It is probable that the number of permanent appointments will be sufficient for those officers whose services have been entirely satisfactory, but no guarantee can be given. If at the end of four years' service an officer's services have been entirely satisfactory, and he is not offered or declines further employment, he will be paid a bonus of 2850 dollars. Salary 400 dollars a month, rising to 800 dollars by annual increments of 25 dollars, plus a temporary non-pensionable allowance of 10 per cent. for bachelors and 20 per cent. for married men. The exchange value of the dollar in sterling is at present fixed by the Government at 2s. 4d., but its purchasing power in Malaya is considerably less than that of 2s. 4d. in the United Kingdom. No income tax at present imposed by the Federated Malay States Government. Free passages provided. Candidates, age 23 to 26, preferably unmarried, must have received a good theoretical training, preferably at a University or College recognised by the Institution of Civil Engineers, and possess a Civil Engineering Degree or obtained such other Diploma or Distinction in Engineering as the Secretary of State may decide in any particular case or have completed articles with a Civil Engineer of good standing, and have passed the examination for Associate Membership of the Institution of Civil Engineers. In addition, candidates must have had at least one year's practical experience of Civil Engineering under a qualified civil engineer.—Apply at once by letter, giving brief details of qualifications and experience and stating age, and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting clearly at the head of application M/15,224. 6282

Civil Engineer Required for the PUBLIC WORKS DEPARTMENT of TANGANYIKA TERRITORY for a tour of 20 to 30 months' service with possible extension. Salary, £480, rising by annual increments to £720 a year (with efficiency bar at £600). Outfit allowance of £30 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, aged 25-35, preferably unmarried, must have been regularly trained as Civil Engineers and have passed Sections A and B of the A.M.I.C.E. Examinations or hold equivalent professional qualifications. Must be capable of Levelling, Surveying, Measuring-up Work and Preparing Designs of Bridges, &c. Must have had at least one year's experience under a qualified Civil Engineer on the Construction of Public Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14,820. 6258

Required for Service under the Government of India an ASSISTANT FOREMAN for the Ordnance Inspection Depot, Hastings, Calcutta (Appointment 94).
Must have had practical experience in the Manufacture and Inspection of Tools; should have had at least a year's experience as a Tool Inspector or Examiner. AGE preferably not more than 30 years, and unmarried. Preference would be given to a man with above qualifications who has attended a technical school and passed qualifying examinations under the London City Guilds or other similar institutions in Mechanical Engineering, Tool-making or Metallurgy.
TERMS: Salary Rs. 450-15-510 per mensem, with prospects of further increases. Agreement for five years in the first instance. Free second-class passage to India and return passage on satisfactory termination of services. Free quarters. Medical examination.
Further particulars and forms of application may be obtained (on request by postcard quoting Appointment No. 94) from the SECRETARY TO THE HIGH COMMISSIONER FOR INDIA, General Department, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications, 3rd September, 1927. 6257

The Royal Technical College, GLASGOW.
DEPARTMENTS OF ENGINEERING.
Mechanics and Mechanical Engineering:
Professor, ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.
Associate Professor, WILLIAM KERR, Ph.D., A.R.T.C.
Electrical Engineering:
Professor, STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
Civil Engineering:
Professor, GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
Mining Engineering:
Professor, DANIEL BURNS, M. Inst. M.E.
Chemical Engineering:
Professor of Technical Chemistry, THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.
Complete courses of instruction are provided, qualifying for the Diploma and Associateship of the College and for the Degree of B.Sc. in Engineering of Glasgow University.
Composition fee, 25 guineas per annum.
SESSION 1927-8 BEGINS on TUESDAY, SEPTEMBER 20th.
Calendar, by post, 3s., and prospectus, gratis, may be obtained on application to the DIRECTOR. 5911

The Engineer

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An Aircraft Works at Yeovil. THE ENGINEER, 19 - 8 - 27.

The Internal Combustion Turbine. (E. C. WADLOW.) THE ENGINEER, 19 - 8 - 27.

A Steam Tractor for Overseas. THE ENGINEER, 19 - 8 - 27.

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PUBLIC NOTICES

University of London, University College
FACULTY OF ENGINEERING.
SESSION 1927-28.
Dean and Director of the Engineering Laboratories: E. G. COKER, M.A., D.Sc., M. Inst. C.E., F.R.S., Professor of Civil and Mechanical Engineering.
Vice-Dean: M. T. M. ORMSBY, M. Inst. C.E.I., Professor of Municipal Engineering.
THE SESSION BEGINS ON MONDAY, 3rd OCTOBER, 1927.
DEGREE AND DIPLOMA COURSES.
Students desirous of entering the Faculty of Engineering with a view to taking a full Degree or Diploma Course must have passed the Matriculation Examination or some other Examination accepted in its stead.
SPECIAL COURSES.
Students who have already undergone a partial training elsewhere and who have attained a sufficient standard may enter for a course occupying less than three years, and may obtain a General Certificate of Engineering after not less than two consecutive sessions' attendance.
POSTGRADUATE WORK & RESEARCH.
Graduates in Science or Engineering, or students who have done the work equivalent to a degree, may be admitted to Special Courses of Study or to prosecute original research.
ADMISSION.
Intending students should communicate with the Secretary forthwith and send a full statement of their previous training.
EXTENSION OF BUILDINGS.
Under the recent scheme of development, about £56,000 has been expended in buildings and equipment to increase existing facilities for training in the principles of science, which forms the foundation of sound engineering practice.
THE NEW BUILDINGS, including the Cowdray Laboratory, the Charles Hawksley Hydraulic Laboratory, a Machine Tools Workshop and a new Laboratory for Experimental Work, are now in full use.
Particulars may be obtained on application to the undersigned.
C. O. G. DOUIE, Secretary.
University College, London, (Gower-street, W.C. 1). 6255

PUBLIC NOTICES

Heriot-Watt College, EDINBURGH.
PRINCIPAL OF COLLEGE—A. P. LAURIE, M.A., D.Sc.
ENGINEERING.
Complete Diploma Courses in MECHANICAL ENGINEERING, ELECTRICAL ENGINEERING and MINING ENGINEERING (COAL, METALLIFEROUS, OIL).
CHEMISTRY.
Complete Courses leading to the Diploma and Associateship of the College in Chemistry, the final year of training being devoted to specialisation in one or more branches of Applied Chemistry. The Courses in Chemisty also include the training necessary for the Associateship and Fellowship of the Institute of Chemistry, the B.Sc. Degree of Edinburgh University in Technical Chemistry, and the B.Sc. Degree of London University (Pass and Honours). Courses in Brewing for the College Diploma and Certificate and for the Associate Membership of the Institute of Brewing.
The Associateship of the College in Chemistry is recognised by the Institute of Chemistry as exempting from Examinations for the Associateship of the Institute of Chemistry (A.I.C.).
Laboratories equipped for Research Students.
PHARMACY.
Courses for Students preparing for the Professional Examinations of the Pharmaceutical Society of Great Britain.
Courses in BUILDING CONSTRUCTION for Builders' Clerks and Surveyors, and in PRINTING for those engaged in Printing and the Allied Trades.
CLASSES OPEN ON 11th OCTOBER.
Entrance Examination commences on 20th September.
Prospectus on application to Principal at the College.
G. MALCOLM STUART, W.S., Clerk to the Governors.
George Heriot's Trust Office, Edinburgh, August, 1927. 6252

PUBLIC NOTICES

University of Bristol.
FACULTY OF ENGINEERING.
(Provided and Maintained in the MERCHANT VENTURERS' TECHNICAL COLLEGE.)
VICE-CHANCELLOR: T. LOVEDAY, M.A.
DEAN of the FACULTY:
ANDREW ROBERTSON, D.Sc., M.I. Mech. E., Assoc. M. Inst. C.E.
DEPARTMENTS.
CIVIL ENGINEERING—Prof. E. M. FERRIER, M.Sc., M. Inst. C.E., M.I. Mech. E.
MECHANICAL ENGINEERING—The DEAN.
ELECTRICAL ENGINEERING — Prof. DAVID ROBERTSON, D.Sc., M.I.E.E.
AUTOMOBILE ENGINEERING—Prof. W. MORGAN, B.Sc., M.I.A.E.
MATHEMATICS—Prof. E. S. BOULTON, M.A., B.Sc.
GEOLOGY—Prof. S. H. REYNOLDS, M.A., Sc.D.
CHEMISTRY—Prof. F. FRANCIS, D.Sc., Ph.D., F.I.C.
Complete courses of study extending over three years leading to the University Degree or Diploma in Civil, Mechanical, Electrical, or Automobile Engineering.
A Sandwich Scheme of Training extending over five years may be adopted by selected students.
Full particulars of courses and of the University Halls of Residence may be obtained on application to the REGISTRAR, M.V.T. College, Bristol.
The Session 1927-28 commences on September 30th. 6081

University of Manchester.
PHYSICS DEPARTMENTS.
Full particulars of the LECTURES and LABORATORY COURSES in PHYSICS, preparing for both the Ordinary and the Honours Degrees, will be forwarded on application to the REGISTRAR.
The Session commences on Thursday, October 6th. 6254

University of Manchester.
DEPARTMENT OF ELECTRICAL ENGINEERING,
DEPARTMENTS OF CIVIL, MECHANICAL AND ELECTRICAL ENGINEERING.
Full particulars of these COURSES will be forwarded on application to the REGISTRAR. The Session commences on Thursday, October 6th. 6253

The Polytechnic, 309, REGENT-STREET, W. 1.
SCHOOL OF ENGINEERING.
President of the School: The Hon. Sir CHARLES PARSONS, O.M., K.C.B., M.A., LL.D., D.Sc., F.R.S., &c.
Head of Department: ALEX. R. HORNE, O.B.E., B.Sc. (Hons. Eng.), F.R.S. (Edin.), &c.
The DAY DEPARTMENT RE-OPENS on SEPTEMBER 20th, 1927. Entrance Examination commences September 12th, 1927, at 9.30 o'clock.
Three-year DIPLOMA COURSES in—
MECHANICAL ENGINEERING,
STRUCTURAL ENGINEERING,
ELECTRICAL ENGINEERING,
MOTOR CAR ENGINEERING.
Practice in the Laboratories, Drawing-office, Work shop and Field.
Fee, 21 Guineas per annum.
There are three Entrance Scholarships in Structural Engineering.
The EVENING DEPARTMENT RE-OPENS on SEPTEMBER 26th, 1927. Students enrolled from September 14th, 1927.
The Day and Evening Courses are recognised for the Diplomas and Certificates issued by the Institutions of Mechanical and Electrical Engineers in conjunction with the Board of Education.
Full prospectus free on application to the DIRECTOR OF EDUCATION. 6250

The Bengal and North-Western RAILWAY COMPANY, LIMITED.
The Directors are prepared to receive TENDERS for the SUPPLY of—
BOILERS FOR LOCOMOTIVES,
as per specification to be seen at the company's offices.
Tenders, addressed to the undersigned, and marked "Tender for Loco. Boilers," with name of firm tendering, to be lodged not later than Noon on the 7th day of September, 1927.
For each specification a fee of 10s. will be charged, which cannot, under any circumstances, be returned.
The Directors do not bind themselves to accept the lowest or any Tender.
By Order of the Board,
W. R. IZAT,
Managing Director.
237, Gresham House, Old Broad-street, London, E.C. 2, August, 17th, 1927. 6279

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WORK WANTED, Page 4.

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PUBLIC NOTICES

Cape Technical College.

CAPE TOWN,
SOUTH AFRICA.
LECTURER IN ENGINEERING.

APPLICATIONS are INVITED from persons who have had a sound technical training, supplemented by practical experience, for the VACANT POST of GRADE I. LECTURER in the DEPARTMENT OF ENGINEERING.

Salary according to scale, £400 x 25 — £500 x 25 — £550.

The appointment will be subject to the conditions of service which, together with College Calendar, may be obtained from the undersigned.

The successful applicant will be expected to assume duty by 1st February, 1928, and will receive travelling allowance to South Africa and also half pay for the voyage out.

Applications should be submitted IN DUPLICATE to reach the undersigned by the 19th September, 1927, and should be accompanied by certified copies of testimonials.

Before appointment the production of birth certificate and a satisfactory medical certificate will be required.

This Department of the College undertakes the instruction of apprentices who are preparing for the Preliminary and National Technical Certificates of the Union Department of Education (see College Calendar), and applicants should preferably have had actual teaching experience of a similar nature.

CHALMERS and GUTHRIE (Merchants), Ltd.
9, Idol-lane,
London, E.C. 3. 6264

City of Coventry.

WATERWORKS.
TENDERS FOR BORE-HOLES.

The Corporation invite TENDERS for the SINKING and TESTING of a BORING or BORINGS at the existing Pumping Station of the Corporation at Watery-lane and at Brownshill Green, near Coventry. At Watery-lane the bore-hole may be 650ft. deep, 30in. to 22in. in diameter; and at Brownshill Green, 300ft. deep and 30in. to 26in. in diameter. The contract includes a second and similar bore-hole at each place, only if the first proves satisfactory on test.

The general conditions, specification, schedule and form of Tender, prepared by Dr. Herbert Lapworth, M. Inst. C.E., 25, Victoria-street, Westminster, may be obtained from the undersigned on or after Monday, August 22nd, on payment of £3, which will be returned on receipt of a bona fide Tender.

Sealed Tenders, endorsed "Tender for Waterworks Borings," to be sent to the undersigned not later than Monday, September 12th.

The contract will only be placed with a firm or person on the King's National Roll, unless the Corporation for special reasons otherwise determine. The Corporation do not bind themselves to accept the lowest or any Tender.

FREDERICK SMITH,
Town Clerk.
The Council House,
Coventry. 6274

City of Leeds.

HIGHWAYS DEPARTMENT.

The Highways Committee invite TENDERS for the SUPPLY of THREE 6-Ton STEAM WAGONS, fitted with mechanically-operated end tipping body, for road works.

Tenders, embodying full specification, with detailed drawings and stating period required for delivery, endorsed "Tender for Steam Wagons," to be addressed to the Town Clerk, Gt. George-street, Leeds, and delivered not later than 10 a.m., 6th September, 1927, and shall remain open for acceptance for four weeks thereafter.

The Corporation do not bind themselves to accept the lowest or any Tender.

E. W. COCKERLYNE,
Highways Engineer.
August 16th, 1927. 6290

City of Liverpool.

CITY ENGINEER'S DEPARTMENT.
TRAMWAY RAILS.

The Corporation are prepared to receive TENDERS for the SUPPLY and DELIVERY of—
200 Tons STEEL TRAMWAY RAILS.

Duplicate forms of Tender for record purposes will NOT be supplied.

Forms of Tender will be forwarded UPON RECEIPT of APPLICATION in WRITING to—
The City Engineer,
Municipal Buildings, Dale-street,
Liverpool.

Tenders must be sealed and enclosed in the official envelope provided, endorsed in accordance with instructions given on the form of Tender, and FORWARDED THROUGH THE POST addressed to—
The Town Clerk,
Municipal Buildings,
Liverpool.

LATEST TIME AND DATE FOR RECEIPT OF TENDERS—10 o'clock a.m. on THURSDAY, 1st SEPTEMBER, 1927.

WALTER MOON,
Town Clerk.
18th August, 1927. 6276

Port of Bristol Authority.

QUAY PNEUMATIC GRAIN ELEVATORS AND CONVEYORS, SHEDS "U" AND "V," ROYAL EDWARD DOCK, AVONMOUTH.

The Port of Bristol Authority is PREPARED to receive TENDERS for QUAY PNEUMATIC GRAIN ELEVATORS and CONVEYORS for Sheds "U" and "V" at the Royal Edward Dock, Avonmouth.

On and after Monday, the 22nd August, copies of the specification and contract drawings can be obtained from the undersigned on production of a receipt showing that a deposit of £5 has been paid. All cheques must be made payable to the Port of Bristol Authority and forwarded to the General Manager and Secretary, Docks Office, 19, Queen-square, Bristol. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

Tenders must be enclosed in a sealed envelope, endorsed "Tender for Quay Pneumatic Grain Elevators and Conveyors," addressed to the General Manager and Secretary of the Port of Bristol Authority, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings before 10 a.m. on Monday, the 19th day of September.

The Port of Bristol Authority does not bind itself to accept the lowest or any Tender.

THOMAS A. PEACE,
Engineer.
Chief Engineer's Office,
Avonmouth Docks,
17th August, 1927. 6292

South Indian Railway Company, Limited.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

1. PRESSED STEEL SLEEPERS.
2. STEELWORK FOR ADAVAR BRIDGE.
3. LOCOMOTIVE TURNTABLES.
4. BRIDGEWORK.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked: "Tender for Pressed Steel Sleepers," or as the case may be, must be left with the undersigned not later than 12 Noon on Friday, the 9th September, 1927, for specifications Nos. 1, 2, and 3, and 10 a.m. on Monday, the 19th September, 1927, for specification No. 4.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of £1 for each copy of specifications Nos. 1 and 2, and of 10s. for each copy of specifications Nos. 3 and 4.

Copies of the drawings may be obtained from the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, of 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.
91, Petty France, S.W. 1,
16th August, 1927. 6287

PUBLIC NOTICES

County Borough of Wallasey.

ELECTRICITY DEPARTMENT.
OVERHEAD ELECTRIC TRAVELLING CRANE.

The Corporation of Wallasey are prepared to receive TENDERS for the SUPPLY, DELIVERY and ERECTION of a 50-Ton OVERHEAD ELECTRIC TRAVELLING CRANE at their Generating Station, Limekiln-lane, Wallasey.

Full information and copies of the specification can be obtained on application at the office of the Engineer and Manager, Mr. B. T. Hawkins, Electricity Department, Seaview-road, Wallasey.

Sealed Tenders, on the form embodied in the specification, addressed to the Chairman of the Electricity Committee, c.o. Town Clerk, Town Hall, Wallasey, and endorsed "Tender for Overhead Crane," to be delivered per post NOT LATER THAN THE MORNING OF THE 17th SEPTEMBER, 1927.

The Corporation do not bind themselves to accept the lowest or any Tender.

By Order,
GEO. LIVESEY,
Town Clerk.
Town Hall,
Wallasey.
15th August, 1927. 6280

Stourbridge and District

WATER BOARD.
PUMPING MACHINERY.

The above Board invite TENDERS for the SUPPLY and ERECTION of PUMPING PLANT, as follows:—

AT MILL MEADOW PUMPING STATION.—ONE One Hundred Brake Horse-power VERTICAL GAS ENGINE, driving through gearing a high lift Turbine Bore-hole Pump against a head of 535ft., including friction, together with all accessories, &c., to make the plant complete in every detail.

AT THE TACK PUMPING STATION.—ONE One Hundred Brake Horse-power VERTICAL CRUDE OIL ENGINE, driving through gearing a High-lift TURBINE BORE-HOLE PUMP AGAINST a head of 310ft., including friction, together with all accessories, to make the plant complete in every detail.

Also a 5 kW D.C. DYNAMO, 220 volts, complete with Switchboard and fittings.

Vertical type engines are specified, but manufacturers may submit alternative Tenders for horizontal type.

Forms of Tender, specification and drawing may be obtained from the Consulting Engineer, Mr. G. Plant Deeley, 13, Church-street, Stourbridge, on and after the 20th inst., on payment of a deposit of Three Guineas, to be returned on receipt of a bona fide Tender, together with all incidental papers supplied therewith.

Sealed Tenders, endorsed "Tender for Pumping Plant," to be sent to the undersigned not later than Noon on Tuesday, the 13th September.

Tenders will only be considered from experienced Engine and Pump Manufacturers.

The Board do not bind themselves to accept the lowest or any Tender.

F. P. EVERS,
Clerk to the Board.
15, Hagley-road,
Stourbridge,
August 8th, 1927. 6207

ENGINE AND BOILERS FOR DISPOSAL.

The Commissioners of the Sutton and Mepal Drainage District

invite TENDERS for the ENGINE, BOILERS and WATER WHEEL, as now standing in their Engine House, near Mepal, Cambridgeshire, as follows, viz.:—

TENDER No. 1.—For THREE BOILERS, about 27ft. long by 7ft. 6in. in diameter, with all valves and fittings, as now working in the boiler house.

TENDER No. 2.—For the 250 H.P. BEAM ENGINE and WATER WHEEL now coupled to the engine, and all fittings, including two columns, as now in the engine and wheel house, excepting chains, spanners, rope tackles, crab, hand pump and all girders.

TENDER No. 3.—For the BOILERS, ENGINE and WATER WHEEL in one Lot, as specified in Tenders Nos. 1 and 2.

Parties tendering are particularly requested to state the earliest date on which they can dismantle and clear.

Any unreasonable damage caused by dismantling to the buildings to be made good.

There is a high road up to the engine.

The Commissioners do not bind themselves to accept the lowest or any Tender.

Tenders to be sent to me not later than Monday, 29th August, next.

C. T. HAMMERTON,
4, Market-hill,
Chatteris, Cambs.,
6266 Clerk to the Commissioners.

Perak River Hydro-Electric

POWER COMPANY, LIMITED.
CIVIL ENGINEER
AND
TWO INSPECTORS.

APPLICATIONS are INVITED (by letter only) from properly qualified candidates for immediate APPOINTMENT to the above POSTS in Malaya:—

CIVIL ENGINEER FOR CONCRETE WORK.

Applicants must have received a good general and technical education, and have passed the Examination for A.M. Inst. C.E., or possess a Degree from a recognised Engineering College and be well experienced in large Concrete Work. Previous experience in a tropical climate is an advantage, but not essential. Age, preferably 28-35 years. Salary £800 to £900 per annum.

TWO INSPECTORS FOR CIVIL ENGINEERING WORK.

Applicants must be experienced Clerks of Works, thoroughly conversant with general work connected with Civil Engineering, especially Reinforced Concrete and Levelling. Age 30-40 years. Salary £450 to £550.

Selected candidates for the above posts will only be appointed subject to passing strict medical examination.

Agreement for about 2½ years and free first-class passage for the Engineer and free second-class for the Inspectors to Malaya, and home again, on satisfactory termination of service.

Applicants must forward details of their career, giving particulars of education (general and technical), practical training and subsequent experience, with names of employers, appointments held and dates of such employment, together with COPIES ONLY of testimonials, &c., to the undersigned as soon as possible, but not later than 27th August, 1927.

RENDEL, PALMER and TRITTON,
Appointments Department,
12, Dartmouth-street,
6275 Westminster, S.W. 1.

Sudan Government Require the

SERVICES of ASSISTANT ENGINEERS for Irrigation Construction Work. Candidates should have passed the Associate Examination of the Institute of Civil Engineers or should hold an equivalent degree. The pay offered will be from £E.480 to £E.600 per annum, according to age and experience, for a two years' agreement (£E.1 equals £1 0s. 6d.).

A VACANCY also EXISTS for a MAN with experience of Decauville Construction Railway Working, and the organisation of transport and distribution of materials to work. Pay according to qualifications and experience.

Apply by letter, giving details of education, training and experience, to ADVISORY ENGINEER, Sudan Government, London Office, Wellington House, Buckingham Gate, S.W. 1, marking envelope "Asst. Engineer." 6270

9th August, 1927.

The Egyptian State Railways

REQUIRE the SERVICES of a SIGNAL INSPECTOR for the Engineering Department. He should have a knowledge of Electro-pneumatic Signalling and at least ten years' experience in Railway Signalling. Salary offered is £E450 per annum; contract period two years.—Application form can be obtained from

THE CHIEF INSPECTING ENGINEER,
Egyptian Government,
6216 41, Tothill-street, London, S.W. 1.

PUBLIC NOTICES

Western Australian Government Railways.

DESIGNING DRAUGHTSMAN WITH EXPERIENCE IN STEEL CAR AND WAGON CONSTRUCTION.

1. APPLICATIONS from qualified DRAUGHTSMEN are INVITED to fill the above POSITION.

2. Applicants must be fully qualified Car and Wagon Designers, and should have had several years' actual experience in the designing of the latest type of Steel Car and Wagon Stock, including workshops practice.

3. Age not to exceed 35 years.

4. Commencing salary £448 per annum, subject to Rules and Regulations of the Western Australian Government Railways and the conditions and privileges of the Departmental Salaried Staff Regulations.

5. The period of engagement will be for three years, with two annual increments of £20 to £488, in accordance with terms of engagement.

6. The successful applicant will require to take up duties at Midland Junction, Western Australia, within four months from date of selection.

7. Second-class fare by mail steamer will be allowed to Western Australia and half-pay on voyage from date of sailing until arrival in Western Australia.

8. Application by letter, accompanied by testimonials and certificate or statutory declaration as to date of birth and nationality, should set forth concisely the technical qualifications, general education, age and experience of applicant, stating whether married or single, and be forwarded to reach the AGENT-GENERAL FOR WESTERN AUSTRALIA, Savoy House, Strand, London, W.C. 2, not later than 30th September, 1927. 6205

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

WANTED, ASSISTANT ENGINEER for Maintenance of Heavy Machinery AC and DC Electrical Plant; must be thoroughly experienced.—Apply to BRITISH GOODRICH RUBBER CO., Limited, Leyland, giving experience, age and salary required. 6285 A

WANTED, ENGINEER with Extensive Experience of the upkeep of large Gas Engines. State age, experience and salary required.—Address, 6273, The Engineer Office. 6273 A

WANTED, SALES PROMOTION ENGINEER, with extensive knowledge of Engineering Concerns, to assist in sales organisation in an Aluminium Foundry and Engineering Works, near London.—Address, stating age, salary required, and full details of experience, 6267, The Engineer Office. 6267 A

WANTED, Young ENGINEER of Good Social standing, education and university degree, workshop experience necessary, for Railway Engineering Firm in Calcutta. Permanent post, officer grade, excellent prospects leading to director.—Address, 6208, The Engineer Office. 6208 A

8th August, 1927.

A RESIDENT ENGINEER is REQUIRED for service in British East Africa.

Candidates, to be considered, must have technical Training, University Engineering Degree or Diploma of one of the principal Engineering Colleges, Workshop, Drawing Office, and a wide General Engineering Experience, including the design, erection, maintenance and running of Chemical Plant and Machinery, Diesel Engines, Alternating-current Generators, Motors, Furnace Work, and a good knowledge of surveying.

The selected candidate, must pass strict medical examination before engagement.

Salary according to qualifications, with a minimum of £800 per annum.

Apply in writing, stating age, full particulars of training and experience, and when could be at liberty, to P3515, The Engineer Office. P3515 A

CHIEF ENGINEER REQUIRED by Important Manufacturing Company having factories in Holland, Germany and France, to Take Charge of the Maintenance and Improvements of Buildings, Machinery and Equipment. Position necessitates residence Continent and frequent visits to factories. Only energetic practical men having good factory experience and thorough knowledge boilers, steam engines, electric generators and motors, also general mechanical equipment need apply. Age about 35 to 45. Knowledge German and French an advantage.—Address, giving full particulars past experience, age, salary required, 6180, The Engineer Office. 6180 A

CONTRACTOR'S ENGINEER and AGENT REQUIRED. Able speak Italian, preferably with experience in Italian construction works.—Address, stating age, experience, and salary required, 6179, The Engineer Office. 6179 A

CONTRACTORS REQUIRE CIVIL ENGINEER for abroad. Good salary to suitable man expert in concrete reinforcement; 18 months' engagement. Early sailing.—Write, stating age and full particulars of experience, to F.C.E., c/o Browns, 39, Tothill-street, Westminster. 6286 A

ENGINEER, Sound Technical Education and Training. Experienced Designer. Knowledge refrigeration and advantage. Full particulars past experience and salary required.—Address, P3513, The Engineer Office. P3513 A

EXPERIMENTAL TESTER. Engineer, Experienced four-cycle heavy-oil engines, to take charge of and develop department of Manufacturing Company. Good mathematician with drawing-office experience desired. Age 30-35. Commencing salary about £450, or according to capability.—CALL C. W. PETTY AND COMPANY (APPOINTMENT SPECIALISTS), 58, HAYMARKET, S.W. 1. 'PHONE GERRARD 3412-3. P3525 A

REPRESENTATIVE.—An Important First-class manufacturer of all kinds of Refrigerating Machinery, Pumps and Diesel Engines is considering the APPOINTMENT of a REPRESENTATIVE for Great Britain. PROPOSALS are INVITED from firms or individuals of good standing, who are free to accept such representation, and who have good connections, especially amongst buyers of Refrigerating Machinery.—Address, P3512, The Engineer Office. P3512 A

REPRESENTATIVE WANTED for POSITION with scope in Sales Department, must have technical knowledge and previous experience.—Write, giving full particulars and salary, to LISTER BROS., Laundry Engineers, Nightingale Vale, Woolwich, S.E. 18. 6293 A

REQUIRED, FULLY-QUALIFIED METALLURGIST, with modern methods, capable of taking charge of Steel and Ironworks Laboratory and Test House.—Address, in first instance, giving age, full particulars of experience and qualifications and salary expected, 6260, The Engineer Office. 6260 A

SALESMAN REQUIRED, Preferably Residing Leicestershire, for De Laval Centrifugal Oil Purifiers, &c. Expert salesmanship combined with engineering and technical knowledge essential. Salary and commission. Good prospects.—DE LAVAL CO., 34, Grosvenor-road, S.W. 1. P3497 A

DRAUGHTSMAN (Capable) WANTED, Thoroughly experienced in marine, steam and oil engine design and pipe arrangement work. Salary, £5 to £5 10s. per week. State age and experience.—Address, 6283, The Engineer Office. 6283 A

DRAUGHTSMAN REQUIRED for Structural Engineers Office, London. Must be expert in design of light steel-framed buildings, and have had experience with actual manufacturers. No others need apply. State age, firms served, when free and salary required.—Address, 6249, The Engineer Office. 6249 A

DRAUGHTSMAN REQUIRED, London District, man thoroughly conversant with Design of Plant for the Pressing and Stamping out of Sheet Metal.—Address, P3482, The Engineer Office. P3482 A

SITUATIONS OPEN (continued)

DRAUGHTSMAN REQUIRED. One Used to Designing Mechanical Movements and Special Automatic Operations. State salary required, age and experience.—Address, P3543, The Engineer Office. P3543 A

DRAUGHTSMAN REQUIRED, with Experience in Factory Construction Work, Steel-frame Buildings and Building Details of all descriptions.—Address, stating age, experience and salary required, P3545, The Engineer Office. P3545 A

DRAUGHTSMAN WANTED, Experienced in all Types of Cranes.—Apply by letter only, giving full particulars as to experience, salary required, &c., to JOHN H. WILSON AND CO., Ltd., Dock-road, Birkenhead. 6272 A

EXPERIENCED DRAUGHTSMEN REQUIRED accustomed Crushing, Grinding, and Cement Making Machinery.—Apply, stating age, experience, salary required, to "W. J. C." Edgar Allen and Co., Ltd., Imperial Steel Works, Sheffield. 6262 A

FIRST-CLASS DRAUGHTSMAN WANTED for Tender Designs of Heavy Steam Breakdown Cranes.—Apply, stating age, experience, and salary required, to Box No. 4051, c/o Brown's, 39, Tothill-street, Westminster. 6271 A

LARGE and Old-established FIRM of Constructional Engineers in India REQUIRE a thoroughly capable STRUCTURAL DRAUGHTSMAN Age not over 25, unmarried.—Reply, giving fullest details, education, engineering experience, present class work and present salary, to Box "Z.N. 783," c/o Deacon's Advertising Agency, Fenchurch-avenue, London, E.C. 3. 6269 A

OLD-ESTABLISHED FIRM of ENGINEERS in India REQUIRE a DRAUGHTSMAN for Roof, Bridge and Structural Steelwork; must be a bachelor. Age 22 to 25.—Write, stating age and experience, to Z.B. 913, c.o. Deacon's Advertising Agency, Fenchurch-avenue, E.C. 3. 6289 A

STRUCTURAL DRAUGHTSMEN (IMPROVERS) REQUIRED for Estimating Dept. and Detailing. State age, experience, salary required, and when ready to commence duties. Only structural men need apply.—BOULTON and PAUL, Ltd., Norwich. 6137 A

TWO DRAUGHTSMEN WANTED for Detailing Work in connection with Steel Office Furniture, Bank and Library Equipment. Accurate and energetic men required, used to preparing manufacturing details from rough construction sketches. Permanency if suitable. Essex, 12 miles from London.—Address, P3541, The Engineer Office. P3541 A

TOOL ROOM FOREMAN—for Large Works in North of England—must be a competent man and thoroughly experienced in Press Tool Designs. State full particulars.—Address, 6291, The Engineer Office. 6291 A

SHORTHAND TYPIST WANTED for Office on the Continent. Age 21-30. Male, single. Spanish. Some engineering knowledge essential.—Write to "K.C.," c/o Streets, 6, Gracechurch-street, E.C. 3. 6265 A

SITUATIONS WANTED

A PURCHASING MAN, Familiar Direct Sources supply of raw materials and finished parts, DESIRES POST (services now available) with electrical or mechanical engineers.—Address, P3520, The Engineer Office. P3520 B

ADVERTISER, A.M.I.Mech.E., Resident in Sheffield, with large and influential connections in district, wishes to REPRESENT MANUFACTURERS or MERCHANTS requiring the services of a man with 20 years' experience, Technical, Administrative and Sales. Speciality combustion; wide personal knowledge of engineering, good linguist, convincing interviewer; payment, salary or commission.—Address, P3518, The Engineer Office. P3518 B

AN Indian Student WANTS to be an APPRENTICE under an A.M.I.C.E. Graduate India, Inter. B.Sc. standard in King's College, London.—Please write to DATTA, 28, Florence-road, Stroud Green, London, N. 4. P3521 B

B.Sc. Eng., London, with 14 Yrs. Workshop experience, covering 5 yrs. app., 3 yrs. general turning, 2 yrs. tool fitting, 2 yrs. machine grinding, 2 yrs. screw gauges; age 30; would like to hear from FIRM with suitable RESPONSIBLE POSITION VACANT.—Address, P3517, The Engineer Office. P3517 B

ENGINEER (23), 5 Years' Public School, Two higher certificates, 2 years' Manchester University, 6 months' chemical works, 12 months' research, 2 years in charge shop precision engineering works, DESIRES more responsible POSITION.—Address, P3539, The Engineer Office. P3539 B

ENGINEER (30), 9 Years' Sea Experience, 1st Class B.O.T. Certificate, 5½ years 2nd engineer, experienced O.F. refrigeration, &c., SEEKS RESPONSIBLE POSITION ashore.—Address, P3502, The Engineer Office. P3502 B

ENGINEERING SALESMAN, with Large Connection in Midland counties, DESIRES CHANGE.—Address, P3544, The Engineer Office. P3544 B

HEATING ENGINEER, Fully Competent, Exp. also in management and sales, SEEKS ENGAGEMENT as DRAUGHTSMAN or REPRESENTATIVE.—Address, P3528, The Engineer Office. P3528 B

MARINE ENGINEER, with 1st Class B.O.T. Certificate and Diesel engine endorsement, age 32 years, 9 years' sea experience and good references, SEEKS POSITION on shore.—Address, P3527, The Engineer Office. P3527 B

SHOP MANAGER MEDIUM WORKS OR ASSISTANT IN LARGE.—YOUNG MAN, public school education, experience modern methods all shops and foundry, two years' responsible position large works, DESIRES CHANGE; energetic, keen on output and production costs.—Address, FOUNDRY, William Porteous and Co., Glasgow. P3526 B

YOUNG CIVIL ENGINEER, 6 Years' Experience, college and pupilage, DESIRES POSITION as IMPROVER; good references; free now.—Address, P3540, The Engineer Office. P3540 B

DRAUGHTSMAN (42) DESIRES POST, London district; 20 years' general experience, 7 years' leading draughtsman.—Address, P3524, The Engineer Office. P3524 B

TRACER REQUIRES SITUATION, 6 Yrs. Experience Aircraft and Engineering. Slight knowledge drawing.—Address, P3514, The Engineer Office. P3514 B

MACHINERY, &c., WANTED

WANTED, ONE Good Direct-current Steam-driven POWER SET, 500 volts, about 200/250 kW., Compound-wound; steam pressure available, 100 lb. per square inch.—Address, 6268, The Engineer Office. 6268 F

150-KW GENERATING SET WANTED; Gas engine driven, direct coupled to 220-volt D.C. compound-wound Generator.—Address, 6251, The Engineer Office. 6251 F

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Wreck Statistics for 1926.

The returns just issued by Lloyd's Register of Shipping showing the number and gross tonnage of ships of 100 tons and over which have been totally lost, broken up, condemned or otherwise removed from the world's mercantile marine, are more than usually interesting, since they deal with not only the last year's losses, but also with the losses sustained each year over the period 1903 to 1926. In 1926 there was a gross reduction in the world's tonnage of 838 ships aggregating 1,343,943 gross tons. Of this total, 656 ships of 1,226,873 tons were steamers and motor ships, and 182 representing 117,070 were sailing ships. Comparing these figures with the 1925 returns, there was an increase of 246,079 tons as regards steamers and motor ships and a decrease of 44,171 tons for sailing ships. That is to say, there was a net increase for 1926 of 201,908 tons. The actual casualties for the year under review showed an increase of 100,492 tons for steamers and motor ships, but the figures are influenced by the fact that 851,232 tons of this class of vessel were broken up during 1926, as against 746,560 tons in the previous year. During 1926 the tonnage of ships owned in Great Britain and Ireland, which were broken up, dismantled, &c., amounted to 153,318 gross tons. Statistical tables are given showing the number and tonnage of ships of all nationalities which have been lost or broken up during the last ten years. Particulars have been so tabulated that a comparison can be made between the different maritime countries of the world of the relative frequency of the different kinds of casualty which conclude the existence of ships. A further interesting table gives the number and tonnage of steamers and motor ships of all nationalities lost through marine and war casualties since 1903, excluding ships which were broken up or condemned not in consequence of casualty or stress of weather. The average percentage of steamers and motor ships belonging to Great Britain and Ireland over this period—excluding the five war years 1914–1918—amounts to less than 1 per cent. of the tonnage owned, while for the year 1926 the figure is 0·71 per cent.

Amended Rules for Heavy Motor Vehicles.

Under the provisions of the Heavy Motor Car (Amendment) Order, 1927, particulars of which were made public by the Ministry of Transport last week, new rules have been laid down governing the design and construction of heavy motor vehicles. For the first time the overall length and overhang of heavy motor cars is prescribed, as is also the turning circle and the clearance of the underparts of public service vehicles. The overall length of a heavy motor car should, according to the new Order, not exceed 27ft. 6in., and any car over 26ft. overall length may not draw a trailer. More stringent requirements as regards brake equipment have been laid down. In the case of a public service vehicle, it is essential that one brake shall be applied by a pedal, and that the operation of either brake shall not in any case disengage the engine from the transmission gear. With regard to axle weights of public service vehicles, the registered axle weight of any given axle must not exceed 5½ tons, and the sum of such weights 9 tons. For other heavy motor cars the corresponding figures remain at 8 and 12 tons respectively. Some interesting modifications as to general requirements have been made in respect of six-wheeled rigid frame vehicles, as such vehicles would appear to offer to the road user special advantages, on account of the better weight distribution over three axles and the reduction in impact. For six-wheeled vehicles the maximum overall length is increased to 30ft. and the greatest unladen weight is raised from 7½ to 10 tons. The sum of the registered axle weight may not exceed 12 tons for a public service vehicle or 19 tons for other vehicles, while for the permissible individual axle weights the figures are 4½ and 7½ tons respectively. The limits which are imposed for the clearance of under parts are also less stringent in the case of six-wheeled vehicles. During the past week the second six-wheeled covered-top omnibus has been put into service by the London General Omnibus Company.

Judge Gary.

Amongst the steel magnates of America, the most eminent was Judge Gary, whose death at the age of eighty years has just occurred. His career was typically American. He was the son of a farmer, took to the law, gained eminence in it, and until he had reached the age of fifty or more had nothing to do with iron and steel save in a legal capacity. It was in 1898 that he became president of the Federal Steel Corporation, which had a capital of about forty million pounds sterling. A few years later he took a step which re-echoed through the world. He established the United States Steel Corporation by absorbing the Carnegie interests. The capital of the Federation was no less than two hundred million pounds. Even America was alarmed. Never before had such a vast organisation been brought into existence, and there was a violent outcry against trusts. The Federation weathered the storm, has flourished to this day, and is now rather a matter of pride than of dislike to Americans. The Judge was an autocrat; there are still not a few to be found in the United States. He would have no dealings with trade unions, was one of the stoutest upholders of the open shop, and insisted on long hours being worked. But he was not unsympathetic, and it must not be forgotten that the model town for steel workmen near Chicago was named Gary after him.

The Railway Returns for 1926.

The annual summary of railway returns for Great Britain, which has recently been published by the Ministry of Transport, reflect clearly the industrial troubles of last year. Taking the mineral traffic, the coal and coke transported decreased by 79, 500,000 tons, compared with 1925, and there was a total loss of freight traffic of 100,000,000 tons, or close upon 31 per cent. An aggregate of 215,500,000 tons was carried, consisting of 114,000,000 tons of coal and coke, 53,500,000 tons of general merchandise, and 78,000,000 livestock. Passenger tickets also showed a slight decrease, but including season ticket holders the number of passenger journeys during the year was 1,541,000,000. Some interesting figures are given with regard to the track and equipment. The total length of railroad open for traffic in 1926 was 20,396 miles, with 52,332 miles of single-track, including sidings. For maintaining the permanent way, about 1,250,000 cubic yards of ballast were used, 3,500,000 tons of sleepers, 180,000 tons of rails and some 370 miles of fencing. Electrified track was increased to 527 miles, compared with 466 miles in 1925. The steam, electric and petrol locomotives totalled 24,432, and there were 51,210 passenger vehicles, including 189 Pullman cars. Practically all the carriages built or purchased during 1926 were fitted with electric light. At the end of last year there were 720,860 goods wagons, with a total capacity of 7,665,856 tons. The train miles which were run during the year were 346,000,000, a decrease of 56,000,000 miles. A total of 689,264 persons was employed on the railways.

The Electrical Industry in Germany.

The decision of the directors of the Allgemeine Elektricitäts-Gesellschaft, of Berlin, to recommend a capital increase of 30,000,000 marks, or £1,500,000, at the next general meeting, which will be held on Monday, September 19th, points to the general prosperity of the electrical industry in Germany. In its recently issued statement the A.E.G. announces that the orders now on hand exceed those of the previous financial year by about 60 per cent. The new capital is required, it is stated, to meet the demands of the company's extending business. General confidence exists with regard to the future of Germany's electrical industry, and we understand that the various electrical manufacturing companies are now obtaining important orders in foreign countries, notwithstanding a certain amount of political antagonism which still remains as a result of the late war. The whole of the new proposed capital of the A.E.G. is to be issued to the ordinary shareholders at 140 per cent., in the proportion of sixty new shares to one already held, while the preference shareholders will be offered ten shares to one already held. With the new increase the capital of the company will be 150,000,000 marks, or close upon £7,500,000.

The New Battleships.

On Saturday last the new battleship H.M.S. Rodney left the Mersey for Portsmouth. She was built and engined by Cammell Laird and Co., Ltd., at Birkenhead, and about four and a-half years have elapsed since her keel was laid. Her principal dimensions are:—A length of 702ft. on the water line; 102ft. beam, and a mean draught of 30ft., with a standard displacement of 35,000 tons. Her sister battleship, H.M.S. Nelson, built on the Tyne by Sir W. G. Armstrong, Whitworth and Co., Ltd., and engined by the Wallsend Slipway and Engineering Company, Ltd., recently joined the Fleet as the Flagship of the Commander-in-Chief of the Atlantic Fleet. Although no particulars have been given regarding the results obtained on her acceptance trials, the performance of the machinery was, we understand, most satisfactory. The contract power of 45,000 S.H.P. was easily attained with a considerable increase of speed over the 23 knots. A special feature of the trial performance was, it is stated, the exceptional economy which was obtained over a wide range of propelling powers. We understand that the consumption of fuel per shaft horse-power, remained practically constant from a very low fraction of the total power up to the full output of the propelling machinery. In this respect the problem of marine turbine design for naval work differs from that of the mercantile marine, in which service the vessel is always steamed under practically full power conditions. Economical working at cruising speeds is a great asset in a naval ship, as it increases the radius of action at those speeds. It is asserted that H.M.S. Nelson has proved to be practically the most economical warship as regards fuel consumption which has so far been completed, which fact must be a matter of congratulation both to her designers and builders.

An Extended Flying Boat Cruise.

In a recent Journal note we referred to the extended flying boat cruise, which will take place in October, to Singapore and Australia. On Friday last, August 12th, a cruise to the Scandinavian capital was begun. It will involve about 3000 miles of intermittent flight, and will continue until about September 11th. The four boats which left Felixstowe at the end of last week included the new all-metal Blackburn Iris II., the supermarine Southampton, the Saunders Valkyrie and the all-metal Short Singapore. Sir Samuel Hoare, the Secretary of State for Air, travelled in the Blackburn Iris II., which boat left Felixstowe a little after ten o'clock on Friday morning, and alighted on the water at Frognerkilen in the westerly part of the harbour at Oslo the same evening at half-past six. The average speed maintained by the Iris II. was 100 miles per hour. After passing through heavy rain in the vicinity of the Dutch coast, the four flying boats had arrived at the port of Esbjerg, in Denmark, at 1.30 p.m. Two of the machines remained at that port, and the other two proceeded at 2.30 p.m. to Oslo as already mentioned, the second machine arriving an hour after the first. Sir Samuel Hoare will visit the Danish Aircraft Exhibition at Copenhagen, and will probably return to England in one of the boats. The other flying boats will complete the itinerary which has been arranged, which includes visits to Oslo, Copenhagen, Gdynia, Danzig, Helsingfors, Stockholm, Copenhagen and Helder, and home to Felixstowe. It is expected that, in addition to the practical handling of the boats, tests of various items of the marine equipment will be made, which will give useful information.

The Clyde Riveters' Strike.

The difficulties which arose out of the recently introduced piecework price list, which was the cause of an unofficial strike on the part of Clyde riveters, were discussed at a joint Conference of Committees representing the Boilermakers' Society and the Clyde Shipbuilders' Association, which was held in London on Friday last, August 12th, and a settlement was reached. A joint committee was appointed to arrange the details of the settlement, and it includes, we learn, representatives of the Executive Committee of the Shipbuilding Employers' Federation and the Clyde Shipbuilders' Association on the employers' side, and representatives of the Executive Council of the Boilermakers' Society and the Clyde riveters on the men's side. It was agreed at Friday's meeting that the terms of settlement should not be made public until they had been communicated to the men, so that a few days will elapse before they are made known. There is satisfaction, however, in learning that when the difficulties which arose were dealt with centrally means were found to overcome them. Had this procedure been resorted to at the beginning of the trouble, no stoppage of work need have occurred. There is to be a further Joint Conference of the Executive bodies of the Boilermakers' Society and the Shipbuilding Employers' Federation, at which the general question of procedure will be discussed.

Two Notable North-East Coast Launches.

On Monday, August 15th, the largest twin-screw motor vessel which has yet been built on the North-East Coast, successfully took the water at the yard of the Furness Shipbuilding Company, Ltd., of Haverton Hill-on-Tees. The Santa Maria, as she is named, has a length of 490ft., with a beam of 64ft., and a measurement of 9000 gross tons. She has been specially designed for the New York-Panama Canal and South American Coast service of the Grace Steamship Company, Inc., of New York. The machinery has been supplied by Sulzer Bros., of Winterthur, and is ready for installation. It comprises two 4000 shaft horse-power, two-stroke cycle single-acting units, each of which has eight cylinders, with a bore of 680 mm. and a stroke of 1200 mm. The designed engine speed is 110 r.p.m., and corresponds to a ship's speed at sea of about 16½ knots. The auxiliaries are electrically operated, and four 275 kW Sulzer oil electric generating sets are provided. There is passenger accommodation for 200 persons, and the holds, some of which are insulated for fruit-carrying, have a capacity of 6800 tons. The Furness Shipbuilding Company Ltd., has, we learn, received an order for a 16,000-ton high-speed oil tanker, which will be propelled by oil engines. A sister ship, the Santa Barbara, will be ready for launching in a few weeks' time. On Saturday last, August 12th, the first launch for many years took place at the yard of Bertram and Sons, Ltd., of South Docks, Sunderland. The cargo boat which was launched was the 395ft. Badjestan for Messrs. Common Bros. She will be engined by MacColl and Pollock, Ltd., of Sunderland.

An American Diary.

No. IV.*

THE HUDSON-AVENUE STATION.

THERE are about two and a-quarter million people in Brooklyn. They make boots, furniture, clothing and tombstones. They use a lot of electricity. The Brooklyn Edison Company sold them 875 million kilowatt-hours last year. The Brooklyn Edison Company employs four hundred messenger boys in its offices. Four hundred messenger boys is a more mentally measurable quantity than 875 million kilowatt-hours.

The most eminent, the largest, the newest of the three power stations of the company is that known as Hudson-avenue. It began work in July, 1924, with two 50,000 kW turbo-alternators, a third unit of the same size went on to load in the following November. These three turbines are supplied with 300 lb. steam. In October last an 80,000-kW machine, with steam at 400 lb. pressure, was started up, so that the present capacity is 230,000 kW. To each unit there are four boilers, and to each boiler the same space is allotted. That is why the last group of boilers is run at 400 lb. They have to supply a much more powerful turbine, and the only way to do that, without increasing the size, is to use a higher pressure. All the boilers—B. & W. type—are stoker fired. There are no air preheaters or economisers for the first twelve; they are just ordinary boilers. The remaining four are supplied with hot air, and they have water screens on the side and back walls. The front wall is carborundum brick. The steam temperature is 700 deg. Fah. instead of 630 deg. Fah.

There is always an interesting problem when two pressures are generated in one station. Suppose you want to use the higher pressure, higher temperature boiler when its turbine for some reason or another is not in use; how is it to be done? At Hudson-avenue the steam mains have been connected to the high-pressure steam after it has passed through a reducing valve and a de-superheater. The latter is just like a U-type feed-water heater, enclosed in a steel drum. An auxiliary water drum is set at the same level as the drums of the 300 lb. boilers. Feed water enters this drum and the level is controlled automatically. The water descends by gravity to the de-superheater drum, where it cools the hot steam passing through the tubes, and in so doing is evaporated, and goes off as steam to the top of the auxiliary drum, and so into the low-pressure low-temperature circuit. It is just after leaving the de-superheater that its pressure is lowered by reducing valves. A very complete description of this boiler equipment was given in a paper which Mr. W. C. Holmes, the superintendent of the station, presented to the A.S.M.E. in January last.

The 80,000-kW turbine is a two-shaft machine—a cross compound—each shaft driving a 40,000-kW alternator. The high-pressure side is single flow and the low-pressure side double flow; both make 1800 r.p.m. for 60 cycles. The high-pressure steam chest is quite separate from the turbine casing; in fact, it is several feet away from it, the connection being made by four long flexible pipe bends. The engineers did not care to run the risk of coupling a steam pipe, 22in. diameter, direct to the turbine, for fear of the strain that it might set up. However, it is done successfully in other cases by using a very great length of almost vertical steam pipe, so that there is lots of room for easy and free adjustment. In the pipe connecting the high-pressure and low-pressure turbines there is a water-sealed expansion joint which is supplied with water from the discharge side of the hotwell pumps, after passing through a gravity feed tank in the boiler-room. The turbine is bled at four points to a closed feed-water heater. The water leaves at about 350 deg. Fah. The condenser has 80,000 square feet; it is horizontal—many American condensers are vertical like those at Lots-road—and is of the two pass radial flow type. The water boxes are divided vertically, so that one-half of the condenser may be used whilst the other is out of use, generally for cleaning. Dirty circulating water is a great trouble in America; in many cases condensers have to be cleaned once a week; in some as frequently as every four days. That is why condensers are sometimes set on end; the mud tends to settle to the bottom. All the Brooklyn Edison power stations are badly off in this respect. They are near large sewers, and with every flood tide the condensers are fouled. They have to be cleaned out with rubber plugs and hot water If the vacuum falls from 28in. to 27½in., a drop equivalent to ·62 per cent. in boiler efficiency or 20 deg. in steam temperature results.

In view of all that has been done in the most modern of modern stations to secure high efficiency, it might be thought that Hudson-avenue with ordinary underfeed stokers, plain refractory walls on many of the boilers, no economisers on any and preheaters on only four, would show indifferent figures. As a matter of fact, its records are admirable. In many, if not all, American stations extremely full daily performance reports are made. At Hudson-avenue such reports are kept with great care for every twenty-four hours, and one of them, for Friday, December 3rd, 1926, is printed here. The first horizontal line of figures indicates the units. The first three are the 50,000-kW generators and the fourth the 80,000. It will be seen that all the turbines were working below load, certainly below their most economical loads, which in the case of the big machine is 65,000 kW. Yet the average water rate for all four was a little less than 12 lb. It will be observed also that a very good vacuum was maintained, but then the temperature of the circulating water was low, 45 deg. Fah. The quantity of circulating water is given in thousands of pounds, and a curious fact will not escape the attention of the reader. The turbine condensate of units 3 and 4 is not very different, yet unit 4 took very much less circulating water than unit 3. In round figures the circulating water per pound of condensate is for the four units 100, 100, 90, and then down to 50 for the last. Now 100 lb. may be taken as high for water at 54 deg. Fah., but, on the other hand, 50 lb. is remarkably low for American practice. It will be seen, moreover, that the outlet temperature of the circulating water was 9 deg. higher for No. 4 than for the other units. All of which seems to indicate that the No. 4 condenser is much better than the other three. Apparently it was in no better condition at the time of the test than condenser No. 2, for from the last line of the table it will be seen that the rate of heat transmission is not very different.

Daily Turbine and Condenser Performance.

Date: Friday, December 3rd, 1926. Hudson-avenue Station.

	Unit No. 1.	Unit No. 2.	Unit No. 3.	Unit No. 4.	Total.
Period covered, hours	24	24	24	24	24
Gross	574,390	240,926	695,180	793,180	2,303,676
KW hours, exc.	3,000	1,130	3,720	4,070	11,920
KW hours, net	571,390	239,796	691,460	789,110	2,291,756
Turbine hours	18·00	6·97	24·00	24·00	72·97
Average load, kW (net)	31,700	34,300	28,800	32,900	31,930
Turbine condensate, lb.	5,760,000	2,496,000	7,392,000	7,440,000	23,088,000
Bleed steam cond., lb.	1,260,000	540,000	1,404,000	2,064,000	5,268,000
Evactor steam cond., lb.	28,800	11,150	38,400	38,400	116,750
Gland water cond., lb.	46,800	18,150	62,400	62,400	189,750
Make-up cond., lb.	—	152,000	520,000	—	672,000
Total cor. cond., lb.	6,944,400	2,854,700	8,175,200	9,403,200	27,377,500
W.R. actual, lb. per kw-hour	12·15	11·91	11·83	11·91	11·95
Per cent. correc. in W.R. due to pres.	+·012	+·017	+·007	—·074	—·009
Per cent. correc. in W.R. due to sup.	—·170	—·143	—·355	—·212	—·220
Per cent. correc. in W.R. due to vac.	+·110	—·044	·000	+·167	+·058
W.R. correc., lb. per kW-hour	12·102	11·740	11·482	11·791	11·779
Bar. correc., space hg. temp., deg. Fah.	30·30	30·30	30·30	30·30	30·30
Steam press. at thr., lb. per square inch	270	272	268	359	270–359
Steam press. at primary, square inch	229	237	220	238	229–238
Steam temp. at thr., deg. Fah.	596	598	575	655	590–655
Superheat, deg. Fah.	183	185	163	216	177–216
Vac. ref. to 30in. bar.	29·14	28·93	29·00	29·14	29·05
Temp. of cond., deg. Fah.	72	75	76	75	75
Thermal eff., per cent.	26·2	27·1	26·7	—	26·7
Circ. water temp., in, deg. Fah.	45	45	45	45	45
Circ. water temp., out, deg. Fah.	54	54	54	63	56
Circ. water, lb. (thousands)	568,400	231,500	677,100	366,900	1,843,900
B.Th.U. loss to river (10°)	511,560	208,350	609,390	660,510	1,989,810
Per cent. loss to river	55·9	55·4	56·4	53·3	55·2
Mean temp. dif. (log), deg. Fah.	22·5	25·5	26·5	21·0	23·9
B.Th.U. trans. per sq. ft. per hour per 1° M.T.D.	180	168	137	164	162

There is one other figure that should be noticed, that for thermal efficiency. An average of 26·7 per cent. for the three turbines is good. The station thermal efficiency for the three low-pressure units is a fraction over 19 per cent., and the B.Th.U. per net kWh is 17,900; for the high-pressure unit the same figures are 22·78 per cent. efficiency and 14,998 B.Th.U. The low-pressure boiler efficiencies range round 78 to 80 per cent., and the high-pressure efficiencies around 84 to 86½ per cent.

Of course, there are other American stations which give better figures. Columbia, for example, reports that a kWh is generated for 12,500 B.Th.U., but it seems to be generally accepted that anything in the neighbourhood of 15,000 is quite good. In this country our best station is probably Barton, which is taking about 16,400 B.Th.U. per kWh sent out, and has a station efficiency of 21·51 per cent.

The arrangements for boiler control in these great American stations is very complete, and in some cases is wholly, and in others semi, automatic. All are plentifully supplied with instruments, nearly always under the eyes of the attendants. The essential thing is, of course, to ensure that just the right amount of air is supplied for the amount of coal burnt. In some cases, therefore, two pens work upon one revolving diagram; one shows the coal and the other the air. It is the business of the boiler attendant to keep the two tracing the same line as nearly as possible. The CO_2 is checked periodically, but is not measured regularly, as it will remain constant as long as the same air is supplied for the same coal. In other stations a flow meter shows the rate of steam consumption, and at the same time regulates the fuel feed. At Hudson-avenue the wind box damper and the uptake damper are controlled by the steam pressure, which also, through a Ward-Leonard arrangement, controls the speed of the stokers and the fans. There is manual control as well, but it is only used when necessary, and the boiler operation is practically automatic.

One more thing remains to be said. It has a human touch about it. In a prominent position the coal rate and the B.Th.U. rate for each watch is prominently displayed in the boiler-room. The boiler efficiency and the name of the responsible attendants are posted on each boiler panel. The men take a very healthy interest in these figures and it is even rumoured that bets are made upon them.

As this is the last station in the New York area to be dealt with, it may be of interest to give a few figures of output. They are taken from a table prepared by Mr. George Orrok as recently as March last, and show the yearly outputs generated in the metropolitan district of New York in 1918 and 1926. The enormous growth in eight years cannot fail to attract attention.

	1918.	1926.
New York Edison and Allied	819,000,000	2,313,000,000
Brooklyn Edison	290,000,000	874,000,000
Public Service of New Jersey	548,000,000	1,377,550,000
Total light and power	1,657,000,000	4,564,550,000
Interborough Rapid Transit	731,000,000	1,062,921,000
Brooklyn Rapid Transit	380,000,000	536,716,000
Public Service of New Jersey	234,000,000	194,000,000
New York Edison and Allied	149,000,000	183,000,000
Total Street Railways	1,494,000,000	1,976,637,000
N.Y. Central and Hudson R.R.	131,000,000	205,600,000
Penn. and L.I.R.R.	165,000,000	239,419,000
		46,731,000
N.Y., N.H. and H.R.R.	40,000,000	57,000,000
Total Railroads	336,000,000	548,750,000
Grand total	3,487,000,000	7,089,937,000

(To be continued.)

The Gatineau Power Scheme, Quebec.

AN engineering enterprise of great magnitude now under way in Canada, is the gigantic hydro-electric development project of the Gatineau Power Company, subsidiary of the International Paper Company, on the Gatineau River, in the Province of Quebec. This is the most extensive hydro-electric development ever undertaken in the Dominion. It involves the erection of a series of huge power plants and the construction of dams and storage reservoirs.

For the first time in the history of Canada, perhaps in the history of the world, a whole river has been taken over, every available source of power marked

* No. III. appeared August 12th.

BIRD'S-EYE VIEW OF THE FARMERS RAPIDS AND CHELSEA POWER PLANTS

THE GATINEAU POWER COMPANY, QUEBEC, ENGINEERS

out, and the greater part of this power harnessed to giant turbines. With the exception of the financing, which has been done largely in the United States, the entire project is Canadian. A Canadian company, the Fraser-Brace Engineering Company, is building the plants, the machinery installed is of Canadian manufacture, and the whole development was designed by Canadian engineers.

The cost of the undertaking will approximate to 50,000,000 dollars, between 700,000 and 800,000 horse-power will be developed when the three plants now under construction are completed, and 200,000 horse-power will be transmitted to Toronto, Ontario, a distance of 200 miles. Included in the development scheme is a large newsprint mill, designed to turn out 700 tons of newsprint a day. This mill will utilise a large portion of the power developed. More than 150 farms have been flooded to make way for the increasing flow of the river ; a railway has been moved back from the river for a considerable distance to avoid flooding ; provincial highways have been moved back to make a new channel for the river ; and at one place, Paugan Falls, the whole river has been diverted through a by-pass to facilitate construction of an eight-unit power plant capable of developing 600,000 horse-power.

All this has been done within a space of two years. Employment has been given to as many as 6500 men at one time, and if a proposed development, 35 miles above Paugan Falls, for which plans have already been drawn up, is carried out, as many more will be employed. A huge storage dam at the head of the river, with an estimated storage capacity of ninety-five thousand million cubic feet, is only a little lower than the Roosevelt and Assouan Dams in point of capacity, and so far as the horse-power available is concerned, the Gatineau development will rank with the 800,000 horse-power enterprise on the Saguenay River in the Province of Quebec, which has made possible the establishment of the big plant of the Aluminum* Company of America.

The power plants are being built at three points along the river. Two of these, at Farmers Rapids and at Chelsea, are close to the city of Ottawa, Capital of the Dominion. The Chelsea plant is designed for an ultimate installation of five units of 34,000 horse-power each, and will operate under a head of 96ft. The dam is 1600ft. long and 100ft. in height. The dam will back the river up a distance of 26 miles to the tail-race at Paugan Falls, impounding about 440,000,000 cubic feet of water. The Chelsea plant is constructed in three steps. The heavy generators and turbines are on the lowest floor ; the transformers, one for each generator, are on the next step, and above them are the control room and transmission lay-outs.

The Farmers Rapids development is about a mile downstream from Chelsea. The power house is designed for five units of 24,000 horse-power each, and will operate under a head 66ft. The total length of the dam, including spillway, power-house sections and wing dams, is 4800ft., and its maximum height is 75ft.

The hydro development at Paugan Falls is 26 miles above Chelsea. The dam which is being built below the falls will back the river up a distance of 30 miles, submerging nine falls and rapids and creating a head of 936ft.

By combining the operation of the Chelsea, Farmers Rapids and Paugan developments into one system, it will be possible to utilise to the best advantage the total fall in the river for a distance of 62 miles from its mouth, and to develop at least two-thirds of the available power in the whole river.

One of the most interesting and spectacular phases of the whole enterprise was the work of regulating the water flow by the erection of a great storage dam at the head of the river. When the Gatineau Power Company bought the rights to develop power on the Gatineau River it immediately entered into an agreement with the Quebec Streams Commission to build a storage dam that would regulate the flow of the river to 10,000 feet-seconds the year round. Surveys disclosed the fact that an enlarged lake, of some 64,000 acres, and drainage 6200 square miles could be created by building ten dams. This enlarged lake would then impound some 92,000,000,000 cubic feet of water.

In January, 1926, the Foundation Company of Canada, Ltd., was awarded the contract to build this work. About 40,000 tons of construction plant and materials had to be transported 35 miles from the nearest railway point to the different dam sites. This was the main problem which faced the contractors. A railway line was the first thought. This meant that 35 miles of railroad would be required through rough, rocky country and across a muskeg, and would also mean a bridge over the Gatineau River of quite a considerable length. In addition, it would take six months to get the railway into commission, and it was absolutely imperative that all the storage dams be completed in the short space of fourteen months. Although there was no precedent to go by the contractors decided to depend upon the gasoline tractor with caterpillar treads to haul this enormous tonnage, winter and summer, over every kind of road conceivable. Roads had to be constructed on both sides of the Gatineau River. It was also decided to copy the steam railway and despatch the tractors from a central office. The tractors have to report back to this dispatcher approximately every 5 miles. This meant building telephone lines to all four jobs. Every possible pound of freight was eliminated to make the hauling problem as easy as possible. Several million board-feet of lumber were necessary, and the contactors immediately set up a portable sawmill and took the logs from the drive in the river and from the low-lying ground which was to be flooded. Sand pits and stone quarries were opened up to get concrete aggregate.

The next big problem which the contractors had to face was the question of securing power to run their machinery. As a temporary and a standby, they installed three solid-injection oil engines generating 500 horse-power. There was a small hydro-electric plant being built a few miles away. The contractors took over the finishing of this plant and the erecting of the transmission line, which delivered 26,000-volt current at the dam site.

By proper organisation the contractors were able to finish two concrete dams, four earth fill dams and three rock fill dams before the winter freeze-up in December, 1926. The main control dam, being a very much larger structure and having all the control machinery installed there, was completed in March, 1927, and the huge reservoir behind these dams is being rapidly filled.

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* In America "Alúminum" is generally used in place of "Alumínium."

A REMARKABLE escape from a serious disaster attended the running of the down Cornish Riviera Express of the Great Western Railway on Wednesday of last week. When travelling between Midgham and Thatcham—on the Reading–Newbury section—the leading wheels of the bogie of the engine left the rails. The train was, however, pulled up without any further derailment.

Reinforced Concrete for Sewer and Conduit Works.

No. III. (*Conclusion*).*

CONCRETE PRESSURE PIPE.

The class of pipe dealt with in this section is one which has been fully appreciated by American engineers in the shape of pre-cast lengths of pipe reinforced bars tied in the form of a cage by circumferential bars, which resist the bursting pressure within the pipe, the concrete being moulded around this cage. Alternatively the steel may be in the form of a thin tube with, perhaps, the addition of a correctly placed light wire cage or meshing, while some makers wind the reinforcement in a machine, producing a former-wound cage complete with the metal pipe ends. In the case of continuous pipe, the metal is placed in lengths as the work proceeds, and the concrete

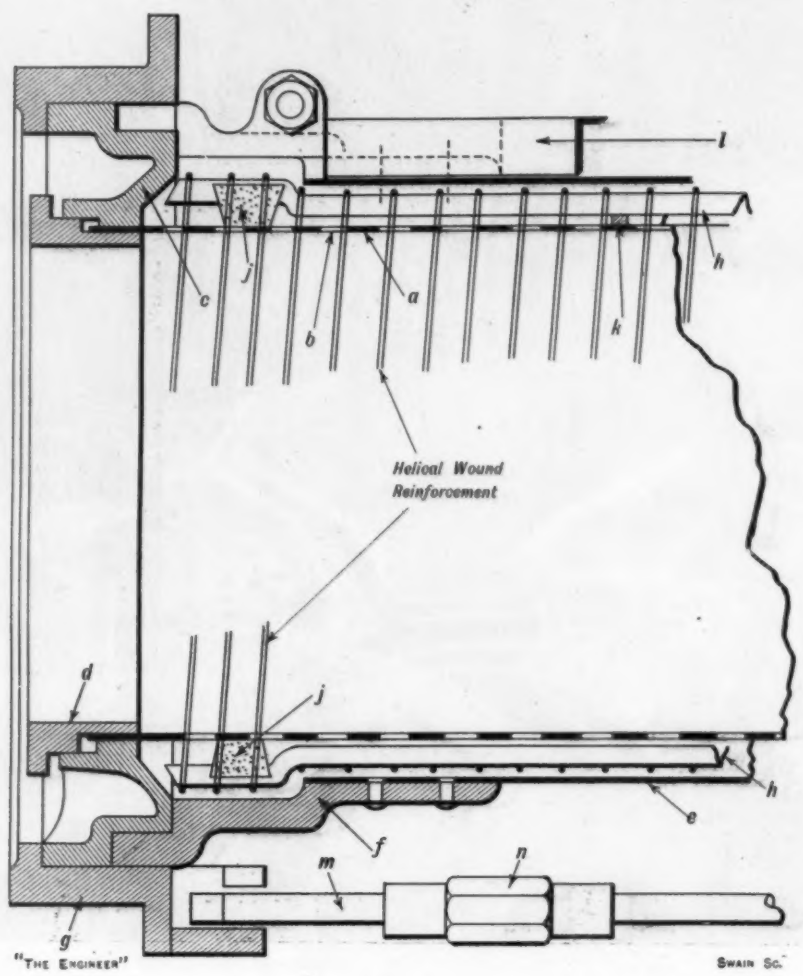

FIG. 18

to carry quite considerable pressures when necessary, jointed in such a way that the joint, while simple to form, is at least as strong as the barrel of the pipe, and is, moreover, capable of dealing with expansion stresses. The formation of these pipes is obviously a specialised business, and where possible it is done at a depôt where suitable equipment is available, but on a large contract, remote from such a depôt, it is a good plan to put down a casting plant so as to save heavy expense in transport. The work involved in casting the pipes is, while of a highly specialised nature, relatively simple. The pipe ends, which are shown later, are in the form of metal rings that constitute the joints, are set up with the moulds and the reinforcement, and suitable concrete introduced into them, the mixture itself and methods of placing being selected with a view to ensuring the maximum density. To this end, seasoning may be partly carried out in an atmosphere of steam, and of late considerable progress has been made in the production of such pipes by centrifugal casting. Centrifugal casting, in fact, has become quite a specialised business, not only in the case of concrete pipes, but for iron or steel

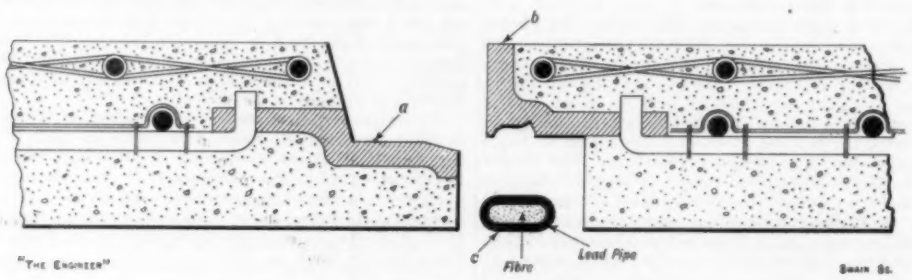

FIG. 19

pipes lined with concrete and for cast iron pipes themselves.

REINFORCEMENT.

Reinforcement for the class of pipe under consideration usually, but not always, consists of longitudinal bars tied in the form of a cage by circumferential bars, which resist the bursting pressure within the pipe, the concrete being moulded around this cage. Alternatively the steel may be in the form of a thin tube with, perhaps, the addition of a correctly placed light wire cage or meshing, while some makers wind the reinforcement in a machine, producing a former-wound cage complete with the metal pipe ends. In the case of continuous pipe, the metal is placed in lengths as the work proceeds, and the concrete is introduced into moulds which are usually of metal.

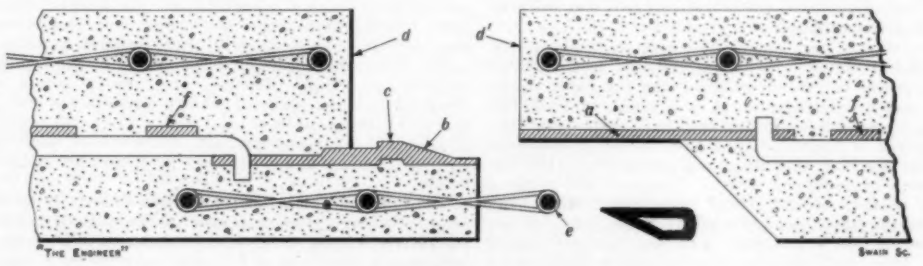

FIG. 20

Mention has previously been made of the use of former-wound reinforcement for the smaller class of pipe, and that known as the "Ferconbar" is now being used for pressure pipes of large diameter.

Illustrated in Fig. 18 it will be seen that there is a metal core at *a*, which may be built up of three or four longitudinal segments, and which constitutes the initial supporting element. It has a number of perforations *b*, through which the concrete is introduced during a centrifugal casting process. This core is mounted in a seat *c*, being clamped up by the locking ring *d*.

The mould *e* and the mould castings *f* may be noted as they will be referred to presently, while the roller path *g*, being mounted on friction rollers, gives the necessary rotational movement to the whole equipment. As regards the reinforcement, it will be noted that behind the core *a* is a series of stamped steel reinforcement retainers at *h*, which run longitudinally the length of the mould, and are of vee section. Moulded on to the ends of these bars are concrete blocks *j*, the purpose of which is to retain the concrete in the mould. These members are supported at intervals between the ends either by concrete blocks, or more usually by the ribs *k*, which are affixed to the core segments. The core then, with its seat and stiffeners—the latter being in the form of light metal spiders arranged at intervals within the core—are assembled and clamped up by temporary end clamping discs tied by a central bar. The whole is mounted between the centres of the winder, the latter being so arranged as to enable the supply of wire to be wound at a uniform pitch and to be fed through tension so that a constant stress is maintained throughout. This tension is sufficient to preclude movement of the "Fercon" bars *h*. The wound core and the seats may now be removed bodily to the moulding machine, where they are housed within the mould casting *f* united to the outer shell *e*. The latter is divided into three or more segments provided with angle irons *l* for bolting the same together. These parts of the rotor are positioned by the annular roller paths *g*, which are held together by the bars *m* drawn up by the turnbuckle *n*. The concrete is then placed by the centrifugal process.

While this particular process undoubtedly makes for good work, simpler methods have proved quite successful, the moulds used, the setting up of the reinforcement and the placing of the concrete all depending upon the individual methods of the pipe makers. In the majority of cases round rods and wire are used, but, as will be shown presently, when joints are dealt with, the outer reinforcement may, for heavy pressures, take the form of welded hoops of rectangular section, and yet again the main reinforcement may be in the form of a metal cylinder as seen in the Bonna pipe. In this system a sheet steel tube is cased inside and outside by a shell of ferro-concrete, and must not be confused with the Hume system, which provides for the lining of steel or iron pipes with concrete, the outer casing of steel being often relatively thin. In the Bonna pipe this sheet steel cylindrical core is acetelyne welded, and outside of it is a reinforcement of longitudinal and circumferential bars of X section, which forms the main reinforcement, while inside of the tube is a light metal cage to hold the concrete lining in place. These three portions are placed in the mould and the concrete cast—centrifugally if necessary for the inside portion—around them. A portion of the steel core is left projecting and forms the joint. That is to say, with the pipe in position, a collar is placed over this projecting end of the cylinder and caulked up with tarred gasket and run lead. The next pipe end is then inserted and also run up with lead. Over the whole is placed a steel ring which is grouted up with cement, the joint being finally pointed up outside and smoothed off inside. The joint, which is claimed to be as strong as the body of the pipe also admits of a certain amount of expansion and will bear the effects of some settlement.

THE AMERICAN LOCK JOINT SYSTEM.

The system of jointing used by the American Lock Joint Pipe Company is definitely designed to permit of expansion, and is both simple and ingenious. Two pipe ends showing the more usual system of joint are shown in Fig. 19, and moulded into the pipe ends and attached to the metal bars are the machined iron spigot *a* and the socket *b*. The jointing ring *c* which is formed of lead pipe filled with gasket and then soldered and flattened to the shape shown, is arranged as indicated in a peculiarly shaped groove in *b*, and on the pipes being drawn together, the wedge form given to *a* causes this gasket to be held immovable in *b* but still permits longitudinal movement of *a*. A watertight joint is thereby effected, which, however, allows of expansion movements taking place. The pipes are drawn up by special tackle; they are not forced home by blows.

Fig. 19 depicts what is known as the lead and iron joint, the spigot and socket being iron castings, but an alternative design in which the same principle is

* No. II. appeared August 12th.

involved is seen in the lead and steel joint in Fig. 20. The metal ends of the pipe are seen at *a* and *b*, the portion *c* of *b* being a running fit in *a*. The two ends of the pipes, *d d'* abut, and the gasket is introduced from the inside of the pipe into the space between *a* and *b* and caulked up by hand. Into the caulking space projects the reinforcement *e*, and this space is finally grouted up. The reinforcing bars *f* may be noted; they are of rectangular hoop form as previously referred to.

The arrangement shown in Fig. 21 is a special form of lead and iron joint for pipes which have a steel cylindrical core and are of necessity somewhat thinner.

SOME GENERAL OBSERVATIONS.

Although pipes of the Bonna class have been used to some extent for a number of years, concrete pressure pipes are a relatively new introduction, which are bound to prove a considerable asset to waterworks and water power engineers.

They will withstand a fair pressure, certainly those usually carried by large pipes. To ensure success, however, it is essential that the very best materials and proved methods of manufacture shall be made use of, as a high degree of density in the concrete, together with a smooth surface are most desirable. The usual concrete proportion for this class of work is 1 : 1½ : 2½, the best quality of sand being used and graded from coarse to fine so as to allow of there being a sufficient amount of very fine matter to come into contact with the cement particle. This, together with the use of steel moulds kept smooth, clean and well oiled will insure a dense water-tight surface. But dust due to the presence of foreign matter must be rigidly excluded, and the fine material should, under the microscope, show a hard glinting surface. Granite chippings are recommended for the coarser aggregate. The joints shown have proved effective in practice, both in resisting pressure and in permitting of a certain amount of flexibility. The limiting radius of curvature, however, obviously depends upon the lengths of individual pipes, their diameter and thickness, and the distance which the spigot and socket

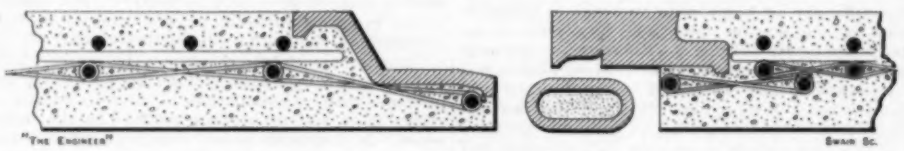

FIG. 21

of two contiguous pipes can be separated from snug contact at the joints on the convex side of the curve. The limit for 36in. pipes, for instance, is about ¼in., which limits the radius of curvature to about 670ft. For other sizes the following values are tabulated:—

Inches.	Feet.	Inches.	Feet.
42	775	66	1165
48	885	72	1310
54	990	78	1415
60	1100	84	1515
	90in.	1620ft.	

Sharp curves may be effected by the use of shorter individual lengths or by casting the bend in place. The latter procedure is generally to be preferred, as the concrete being cast against the wall of a trench, or if laid on the surface against a block of concrete, has a bearing upon which unbalanced pressure may be taken, such pressures being known to occur at bends.

Amongst recent works may be mentioned 10 miles of 66in. pipe at Winnepeg, which operate under 45ft. head and pipes of 9ft. diameter at Baltimore operating under 80ft. head. There are several other interesting examples in America, while in Britain, where the system has not as yet been widely adopted, may be mentioned 54in. Bonna pipes on the Birmingham Waterworks line from Elan Valley which work under 240ft. head, and a length of 60in. pipe in the Severn syphon section which operates under no less than 370ft., or a pressure of some 160 lb. per square inch. As regards relative cost when compared with iron or steel pipes or wood stave, when the latter is feasible, it is difficult to speak generally since cost is more or less influenced by local conditions, but even though a saving in first cost may not be effected, the durability of concrete over iron and steel must be taken into account, not only from the standpoint of direct corrosion, but also from that of discharge, which in the case of metal pipes often becomes seriously affected by fouling.

Further information on concrete sewer and conduit work is contained in a paper by Mr. E. R. Matthews, A.M. Inst. C.E., in Trans. Inst. C.E., Vol. CLXVII.

THE British Broadcasting Corporation engineers at Keston some time ago tried an interesting experiment for overcoming the fading trouble often experienced with short-wave broadcasts from America. Two of these stations happening to be transmitting the same programme on different wavelengths, which were both received by Keston, united and retransmitted, with the result that the fading effect was almost entirely eliminated.

The Internal Combustion Turbine.

By E. C. WADLOW, Ph.D., B.Sc.

IN the following article, the problem of the internal combustion turbine is discussed in general terms. It is shown that the prospects of turbines of this type are not good, owing, in large measure, to their low overall efficiency, for which compression difficulties, resulting in high negative work, are mainly responsible. In considering this type of prime mover in conjunction with both steam turbines and internal combustion piston engines, great care must be taken to obtain an impartial view of the merits of the mechanisms and cycles independently of one another. Otherwise erroneous conclusions as to the possibilities of the gas turbine may be drawn. A true comparison serves to show, as stated by the author, that the gas turbine "combines, in fact, most of the drawbacks of each" (steam turbine and explosion piston engine) "without having their separate advantages." In these circumstances, the possible fields of operation must inevitably be few, and dependent upon certain favourable conditions obtaining. The result is that the internal combustion turbine is unlikely to make rapid progress, even when the technical difficulties have been overcome.

So much has already been written concerning the internal combustion turbine that the presentation of anything further of a general nature dealing with the theoretical side must call for some explanation. The justification, in the present instance, is that a number of misconceptions, regarding the potential uses of, and difficulties presented by, this prime mover still exist, and it is with the hope of removing some of these that a concise summary of the position is being presented. A proper understanding of the scope and limitations of the internal combustion turbine is very desirable, as it is obvious, from descriptions of machines which appear from time to time in various journals and from other sources, that a large percentage of the designs which are published are of little commercial value, and would be dropped at a very early stage by their inventors if the whole matter had been given more serious consideration.

At first sight, a turbine working on an internal combustion cycle appears to possess several advantages over existing types of prime movers. From a mechanical point of view only, the substitution of turbine mechanism for reciprocating is often very desirable. Owing to the purely rotary motion of the moving parts, and consequent freedom from vibration, high rates of revolution are permissible, and the size, weight and cost of the machine can be very much reduced. A further advantage may also reasonably be anticipated from experience with reciprocating and turbine steam plant, namely, that of practically unrestricted output per machine. The limit imposed upon this quantity by employing reciprocating mechanism is very clearly shown in Diesel engine practice, where the usual method of obtaining increased output is by duplication of plant; increase in the size of the unit is comparatively slow. In the reciprocating steam engine, the limit has, for practical purposes, been reached.

If, with the above advantages attending the employment of the turbine could be associated the high brake thermal efficiency of the internal combustion piston engine, a machine having many very desirable characteristics would result.

It is distinctly unfortunate, however, that this view of the gas turbine is incomplete. It will be observed that it deals with the advantages of the turbine and of internal combustion cycles, judged only from the merits of the steam turbine and of internal combustion piston engines respectively, and takes little account of the absolute merits of the mechanisms and cycles considered separately.

It is generally overlooked that the turbine wheel, as a means of utilising the potential energy of the working fluid, is, in itself, much less efficient than the cylinder and piston. The success of the steam turbine is due in great measure to the suitability of the turbine for the steam cycle, and once the two are separated, many of the advantages of the turbine disappear. With a condensable fluid such as steam, high expansion ratios are possible without a corresponding great increase in the negative work of the cycle. The turbine may be designed without much difficulty to utilise these high expansion ratios, whereas the reciprocating steam engine cannot. To work between the same pressure and temperature limits, the reciprocator becomes exceedingly large and costly, and its mechanical efficiency low. For moderate expansion ratios, however, it is more efficient than the turbine, and hence, as long as these ratios are employed, the demand for the reciprocating steam engine will continue. It is hardly necessary to point out also that variations from the designed speed adversely affect the efficiency of the turbine much more than is the case with the piston engine. The steam turbine, therefore, is a success because of the favourable combination of turbine and extended steam cycle, and not because of any inherent superiority of the turbine from the point of view of mechanical efficiency only.

The higher brake thermal efficiencies obtained with internal combustion engines also tend to be misleading, inasmuch as the conclusion may be reached that the working cycle employed is considerably more efficient than the steam cycle. In reality, the advantage on this score generally possessed by the piston engine is due to the greater efficiency of its mechanism. When the indicated thermal efficiencies of the cycles are compared, it will be found that there is very little difference between them. The one great advantage possessed by internal combustion cycles lies in the high rate of heat addition possible, resulting, with suitable design, in a plant with a very high power/weight ratio.

The gas turbine, therefore, is different in many ways from either the steam turbine or the internal combustion piston engine. It combines, in fact, most of the drawbacks of each without having their separate advantages. The high expansion ratios, for instance, so easily obtained with steam, are no longer available when the working fluid is a nearly perfect gas without an enormous increase in the negative work of the cycle. In the former case, changes of state of the working fluid provide the necessary volume alterations, but in the latter mechanical compression and exhaustion are the only means available, and the efficiency with which these operations can be carried out becomes of greater importance.

Turning to the expansion of the fluid in the turbine, with the much lower expansion ratios possible, the advantages associated with the turbine when working on the extended steam cycle cannot reasonably be anticipated, and, indeed, there is little likelihood of their being obtained. Over the range of pressures and expansion ratios likely to be encountered, the reciprocating engine is much more efficient mechanically, though, unfortunately, it has the drawbacks already enumerated.

The fact cannot be over-emphasised that the turbine lends itself only to use with a cycle in which the amount of negative work is small. At the present time, if the negative work is high, and has to be performed by means of a mechanical compressor of the turbine type, the employment of a turbine to utilise the energy of the expanding gases can only result in the cycle being worked with fairly heavy losses.

It seems, therefore, as though the very existence of the gas turbine is dependent upon certain special conditions obtaining. But before attempting to indicate these, it is perhaps advisable to consider briefly the means available of compressing the working fluid, and, afterwards, two possible cycles of operation, their respective merits and difficulties.

COMPRESSION.

The most efficient way of obtaining the necessary degree of compression is to employ piston compressors, as the efficiency of this type is greater than that of the turbo-compressor, and, at the same time, the maximum pressures obtainable are considerably greater. The employment of such compressors, however, immediately modifies the conception of the internal combustion turbine; in a true sense, it is a turbine no longer. The complications and vibrations of reciprocating units are present once more, and the size of unit possible is restricted as in the piston engine. For a moderate turbine set, the size of compressor required becomes enormous.

The remaining alternative is the turbo-compressor. The employment of this type is absolutely in keeping with one of the ideals of the internal combustion turbine—namely, the elimination of reciprocating motions. Efficiencies of turbo-compressors, and the maximum compression ratios available, are comparatively low, but the machine has the advantage that it can deal with large volumes, that its size is not excessive, and that it possesses the advantage of having rotary motion only. Low efficiency and inability to reach moderate compression pressures constitute its most serious disadvantages, and herein lies the greatest scope for improvement.

THE CONSTANT PRESSURE CYCLE.

When heat addition and rejection take place at constant pressure, the expansion and compression ratios are equal, and must be maintained entirely by the compression mechanism. The compressor may be either of the reciprocating or of the rotary type; the relative advantages of each have already been briefly indicated. The main drawback of this cycle is that the ratio of positive to negative work is low, and this fact greatly offsets a number of other advantages possessed by machines working under these conditions. Unless great care is taken, this ratio may be so low, owing to inefficiency of compression, that the machine is unable to turn itself round.

Theoretical analysis of the cycle, taking into consideration the probable efficiencies of the turbine and of the compressor, indicates that little advantage

is to be derived by employing compression ratios exceeding ten, and as turbo-compressors of considerable size have been constructed to give ratios almost as high as this, part of the problem may be regarded as almost solved, or at least soluble. An improvement in the efficiency of compression would be very desirable from the point of view of the overall efficiency of the turbine, and is very necessary if success is to be achieved.

A factor which has a very great determining influence upon the success or otherwise of the constant pressure turbine is the permissible blade speed. With an expansion ratio of ten, and a moderate gas temperature before expansion, exit velocities of about 4000ft. per second must be provided for, and, as the reaction type of turbine is entirely out of the question, single and two-row velocity compounded wheels only are available. The single row wheel gives the highest efficiency, but at a blade speed at present quite prohibitive, while the speed of maximum efficiency of the two row wheel, occurring at about 880ft. per second, is slightly higher than one would care to go with large wheels at the present time. Higher speeds than this have been used satisfactorily, but with wheels of small diameter.

So far the temperature question has been entirely neglected, but its influence upon the permissible blade speed is very important. As the strength of the blades and wheel falls off rapidly with increasing temperature, a limit is also fixed by this consideration only. Experimental wheels of small diameter have been run successfully at a bright red heat with considerable peripheral speeds, but this, while showing that progress is being made, does not necessarily indicate that the problem is satisfactorily solved. Experience with high temperature and pressure steam plant is decidedly useful in providing guidance, and here considerable reluctance is shown in exceeding temperatures above about 400 deg. Cent. Such a temperature is too low to be of much use as the blade temperature in constant pressure turbines. The temperature in the combustion chamber is determined by the gas exit temperature, the compression ratio being fixed, and if this latter is ten to one or less, and the exit temperature is to be not higher than even 500 deg. Cent., a considerable amount of excess air must be pumped into the combustion chamber to keep the temperature down, or recourse must be made to steam injection. The use of weak mixtures greatly increases the negative work of the cycle, and renders the constant pressure turbine an impracticable proposition at the present time, while the use of steam injection, water injection, or the use of steam to drive separate turbine wheels, adds additional complication to the plant, although by these means the overall efficiency may be somewhat raised.

When favourable efficiencies are assumed for turbine and compressor, the overall efficiencies of constant pressure turbines are low, and a value of about 20 per cent. is unlikely to be exceeded. Unless, therefore, the machine possesses special merits, it is going to experience great difficulty in making headway against its competitors already established. In addition, it must be observed that any advances in metallurgy which are favourable to the internal combustion turbine are equally favourable to its competitors, the steam turbine and the internal combustion piston engine.

Although experience is necessary to determine the best form of many of the details, on the whole, the design does not present any very great difficulties. For example, the continuous combustion of gaseous or liquid fuels in fairly small combustion chambers, at high pressures, can be carried out fairly easily. The expansion of the products of combustion in nozzles may call for some experimental work, and cooling of the nozzles and combustion chamber will probably be essential. Starting up should be carried out without difficulty, and speed regulation presents no problems not already encountered with other prime movers. It must not be inferred from this that it is possible to design a successful turbine at the first attempt; but it should be understood that the difficulties are such as to be overcome by careful attention to detail, by access to specialised knowledge concerning the many problems involved, and by judicious experimenting rather than by isolated attempts by inventors lacking working facilities and considerable financial resources.

The Constant Volume Cycle.

Familiarity with the petrol engine is probably responsible for the considerable attention from inventors received by this cycle of late, and descriptions of "successful" machines are quite common. Actually, the rate of progress is exceedingly slow. The line of attack most usually adopted is that of compressing and exploding the working charge as is done in a reciprocating internal combustion engine, followed by allowing the gases to escape past a valve, through a nozzle and thence on to a turbine wheel.

The cycle itself possesses certain fundamental advantages when compared with that already considered. Foremost among these is the high ratio of positive to negative work obtained, owing to a considerable amount of the pressure rise being due to the explosion; hence the relative unimportance of the compressing mechanism. This fact reduces the size of compressor required very appreciably compared with that for a constant pressure turbine of similar output. The turbo-compressor thus has a much better chance of being able to satisfy the necessary stipulations.

With this cycle, however, the torque cannot be uniform, being due to a series of gusts. This system also renders imperative explosion chambers, valves and valve-operating mechanism, and on this score is no improvement upon the internal combustion piston engine. It is true that the combustion chamber may be made of a more efficient shape, and that troubles due to pistons are eliminated; but the conditions imposed upon the valves are decidedly more exacting. The nozzle valve, in particular, controlling the passage of the exceedingly high-temperature gases from the combustion chamber to the nozzle, is subject to very heavy duty. One has only to think of the troubles connected with exhaust valves in piston engines, and to compare the pressure and temperature conditions in these and in the turbine, to realise the treatment the nozzle valve of the latter must be able to withstand.

The temperature conditions obtaining in the turbine wheel casing are dependent upon various considerations determined by each design, but the efficiency of the nozzle and blading is likely to be anything but high under this system of operation.

Compared with turbines working on the constant-pressure cycle, explosion turbines suffer from a further disadvantage, namely, that the choice of fuel is restricted to gas or to liquid fuels of a volatile nature, such as petrol or paraffin. This is likely to prove somewhat of a handicap in several potential fields of operation.

Finally, when all the difficulties have been overcome, theory promises an overall efficiency of about 20 per cent. only, with a possible slight improvement if regeneration and other means of extending the cycle limits be employed.

Future Developments.

It cannot be said, therefore, that the prospects of the internal combustion turbine are particularly bright, and the fact that progress is so slow seems to prove that this conclusion is correct.

The difficulty of being able to build a workable turbine—which was at one time very real—is no longer present. Knowledge of turbine and compressor design, of steels and special heat-resisting alloys, and of refractories, has increased very considerably during the last twenty years. Of the difficulties still existing, those of building efficient turbo-compressors and of producing steels possessing high strength and non-scaling properties at elevated temperatures, are most important. The building of successful machines will call for considerable knowledge of and experience with turbine machinery, and with the process of combustion. It is, therefore, likely to be best carried out by firms already engaged upon work of a similar nature.

With the major problems so clearly defined, and the abundance of technical ability possessed by the engineering firms of this country, there is very little chance for the inventor not possessed of considerable financial resources, and he would probably be well advised to turn his attention to other and more profitable fields.

Many of the schemes which appear from time to time seem to indicate that their originators are only partially acquainted with the complete problem. To produce a workable turbine is clearly insufficient. To be commercially successful, the turbine must be capable of doing the work of an existing prime mover, and of doing it better—either more conveniently, more expeditiously, or more economically. With maximum obtainable efficiencies of the order of 20 per cent. only, there is little likelihood of much advantage on the score of economy, unless the turbine is able to utilise very cheap or waste fuel. Even with regard to convenience and to expeditiousness, the turbine is likely to have a struggle to obtain a start, as it can do little which cannot be done already by existing types of power producer. The internal combustion turbine, then, seems likely to find application in specialised fields only.

The one prime mover which it may beat on grounds of efficiency is the small stationary steam plant, consisting of engine and boiler, which is often very inefficient. Generally, however, a simple substitution of plant is impossible as the available fuel will be unsuited to the needs of the gas turbine. If coal or other solid fuel be employed, a gas producer must be used in conjunction with the turbine, and this addition, while complicating the plant, will also probably render its first cost too high to compare favourably with the steam plant. To find a small steam plant using gaseous or liquid fuel is somewhat unusual, and in such circumstances the gas turbine has a much better chance of ousting this competitor. The trouble, in this case, is that the work would probably be done even better by a gas or an oil engine.

A field of operation generally regarded as favourable to the employment of internal combustion turbines is where large volumes of gas are evolved as a by-product, as in blast-furnace work. Burning this gas in large gas engines or in boilers is attended by certain drawbacks. The latter scheme necessitates a large boiler plant in addition to the turbine plant, while the gas engine is very large, heavy, and costly for its output, although its efficiency is high. Furthermore, duplication of the unit is the only means of obtaining large powers. The constant pressure turbine, working on a sub-atmospheric cycle, seems to have a real commercial value in this field. Cooling of the gas, essential if it is to be used in gas engines, would be unnecessary, and this, while simplifying the plant somewhat, is advantageous from the point of view of efficiency. As the combustion of the gas takes place at atmospheric pressure, no difficulty would be encountered in using a large combustion chamber, and the fact that in no part of the system is the pressure above atmospheric should lessen the stresses in the parts and should make pressure-tight joints easy to maintain. There is no reason why such a machine should not be built to give large powers on a single shaft. If only the efficiency of turbo-compressors could be improved considerably and materials could be produced able to withstand higher temperatures than at present, the gas turbine of this type would seem to have a very real opening where large volumes of waste gas are available.

The demand for many of the constituents of raw coal, which has resulted in increased attention being directed to the carbonisation of coal, particularly at low temperatures, may also assist the progress of the gas turbine. In such carbonisation plants the turbine would be an auxiliary only and the success of the process is far from being dependent upon the economical production of power from the gas evolved. The lower efficiency of the turbine plant is not likely, therefore, to be a great handicap if its use is otherwise found to be convenient.

In Germany, explosion turbines of considerable output have been constructed by Holzwarth, but although the individual machines have been successful from many points of view, the fact that this type of turbine has not found increased application seems to indicate that it offers no very great advantages over existing plant. The only real and satisfactory method of determining the merits of such machines is to build examples for a particular purpose and to compare their cost with that of other prime movers working under similar circumstances. The margin of advantage of the turbine on paper is so small as to be easily reversed by slight unforeseen incidents. Such a plan of procedure is, however, not likely to be put in operation at the present time, owing to the condition of the engineering industry generally.

Considerable attention seems to be devoted to the class of small explosion turbine having piston compressors with cylinders placed radially round the crank shaft and in a plane parallel to the turbine wheel. It is difficult to see what is expected of these machines; their overall efficiencies are not likely to exceed about two-thirds of those of the conventional piston type, their weight is likely to be at least 50 per cent. greater, and they possess additional complications in the valve gearing.

The idea of utilising gas turbines for aircraft propulsion has been fairly fully explored. The conclusion reached is that neither on the point of power/weight ratio, nor on grounds of fuel economy will the turbine plant be able to compete in the immediate future with reciprocating engines of equal power output. Ultimately, when the difficulties already pointed out have been overcome, the simplicity, perfect balance, possibility of using heavy fuel oil, silence, and absence of lubrication troubles, possessed by the constant-pressure turbine, may enable it to oust its reciprocating rival.

In the field of marine propulsion the difficulties in the way of the gas turbine are somewhat similar to those occurring on land, but more acute. The Diesel engine has made such rapid strides of late, and has demonstrated very fully its reliability and economy, that no serious attention seems to have been given to the claims of the gas or oil turbine. Later on, when the Diesel engine has more nearly reached its constructional limits, the case for the gas turbine may be reconsidered. Meanwhile, the introduction of higher steam pressures and temperatures promises to give a new lease of life to the steam turbine in this field.

Thus progress in specialised fields which forwards the case of the internal combustion turbine also helps its competitors, and the relative positions to-day are not greatly different from those of five, fifteen, or twenty-five years ago. Success calls mainly for improvements in the design of turbo-compressors, in the production of cheap heat-resisting steels and alloys, and the availability of large supplies of waste gaseous fuel. Even should all these come about, the fact that very considerable financial resources will be necessary to carry out any comprehensive and useful project must not be lost sight of. With so many factors involved, one cannot say, at the present time, exactly wherein the greatest difficulty lies.

The Welland Ship Canal.

One of the most notable engineering projects undertaken in Canada in recent years is the construction of the Welland Ship Canal, which forms an important link in the Great Lakes—St. Lawrence Waterway—and is now nearing completion.

The Great Lakes and the St. Lawrence River form a system of waterways which extend inland to the heart of the Continent. Canals have played an important part in overcoming the many obstacles which occur along the great water highway. In the route from Montreal to Fort

THE WELLAND SHIP CANAL

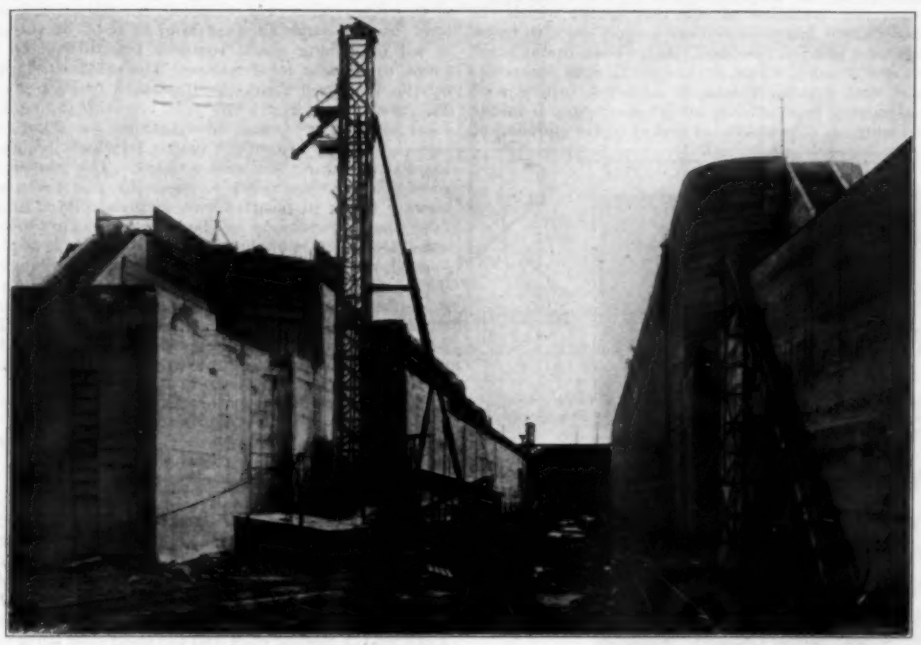

FIG. 1—LOCK NO. 1, LOOKING TOWARDS BREAST WALL

William and Port Arthur, a distance of 1214 miles, there are 74 miles of canals, with 49 locks and 1140 miles of river and lake waters. One of the most important units in this system is the Welland Canal, constructed across the Niagara Peninsula between Lake Ontario and Lake Erie, which overcomes the obstruction to navigation along the Niagara River caused by the famous falls of the same name.

The canal now under construction will be the fourth to be built across the Niagara Peninsula, since the beginning of the first canal in 1824. The new waterway will decrease the distance from lake to lake from 26¾ miles to 25 miles, and the number of locks will be reduced from twenty-six to eight. The huge project, which is costing the country approximately 115,000,000 dollars, will probably be ready for navigation within three years.

Of the eight locks—see Figs. 1 and 2—in the 25 mile stretch, three ascending the escarpment will be double so that boats may ascend and descend at the same time. The time required to pass a vessel through one of the locks, which will be 829ft. long and 80ft. wide, will be about 35 minutes, and the actual time necessary to fill or empty one of the locks will only be eight minutes. The estimated time to pass a loaded vessel from lake to lake will be eight hours, as compared with 15 to 18 hours on the present canal. Up to the present the length of vessels reaching Lake Ontario either from the St. Lawrence River or from Lake Erie has been about 250ft., but with the completion of the new canal it will be possible for the 600ft. freighters now plying the upper lakes to pass into Lake Ontario and the Upper St. Lawrence.

At present 12½ miles of the 15 mile summit reach is being excavated to a depth of 26½ft., and in the other canal reaches the same depth is being provided in rock excavation. The remainder of the canal reaches will have an initial depth of 25ft. The canal structures are being sunk to 30ft., so that the waterway may be deepened at any future date without involving the permanent works. The canal reaches are being made 200ft. wide at the 25ft. depth and 310ft. at the water-line. These dimensions place the present work in the front rank, and, in fact, in some respects it stands unequalled. The Panama Canal has a highest level of 85ft. above sea level, and the highest lift for any lock is slightly over 30ft., as compared with 46½ft. negotiated at each lock of the new Welland Canal. Furthermore, a flight of three twin locks at Thorold effects a rise of practically 140ft., and its "mass concrete" is comparable with the great Gatun Locks at Panama.

There will be twenty-one bridges across the canal to carry existing highways and roadways, as well as several bridges over "pondages."

The work is divided into nine sections, extending from Port Weller, 3 miles east of Port Dalhousie, on Lake Ontario, to Port Colborne, on Lake Erie. Section one embraces the construction of an entirely new harbour by means of earth and rock embankments for the Lake Ontario entrance to the canal. This harbour extends about 1¼ miles out into the lake from the original shore line to deep water. Section two is the first section proper of the canal, starting at Lake Ontario, and extends southward about 4½ miles. Both of these works are completed. Sections 3, 4, 5 and 6 are practically completed, but considerable work remains to be done on sections 7 and 8.

Contracts for sections 1, 2 and 3 were originally awarded in 1913, but, because of war conditions, construction work on the canal was suspended in January, 1917, and the contracts were formally abandoned under agreement early in 1918. The value of the contracts was 20,350,000 dollars, and the total expenditure on the work to the end of 1918 was 16,069,000 dollars, which included the purchase of plant, materials and stores from the contractors. Work was resumed on a cost-plus basis in January, 1919, and to March 3rd, 1921, the total expenditure on the work was 25,340,000 dollars. About that time it was decided to abandon the cost-plus arrangement as soon as it could be effected, and to relet by contract at schedule rates. The original estimate of 50,000,000 dollars as the cost of the canal was not regarded as final, and at prewar rates the canal would probably have cost about 60,000,000 dollars. Unit prices of to-day's contracts, compared with those of 1913, show an increase in general of 100 per cent. or more. The average rates of fifteen of the main classes of labour show an increase of 120 per cent. between those of 1914 and 1926. Cement shows an increase of 78 per cent., and during 1926 over 500,000 barrels of cemenet were accepted for construction purposes on the canal.

The history of canal communication between Lake Erie and Lake Ontario is one of almost constant enlargement and reconstruction to meet the rapid growth of trade and commerce on the Great Lakes, and the consequent steady increase in size of vessels plying these waters. At no time during its existence of nearly a century has the Welland Canal been able to keep very far ahead of the development of lake trade, but it is confidently expected that the capacity of the new Welland Ship Canal will be sufficient to provide for marine development for many years to come.

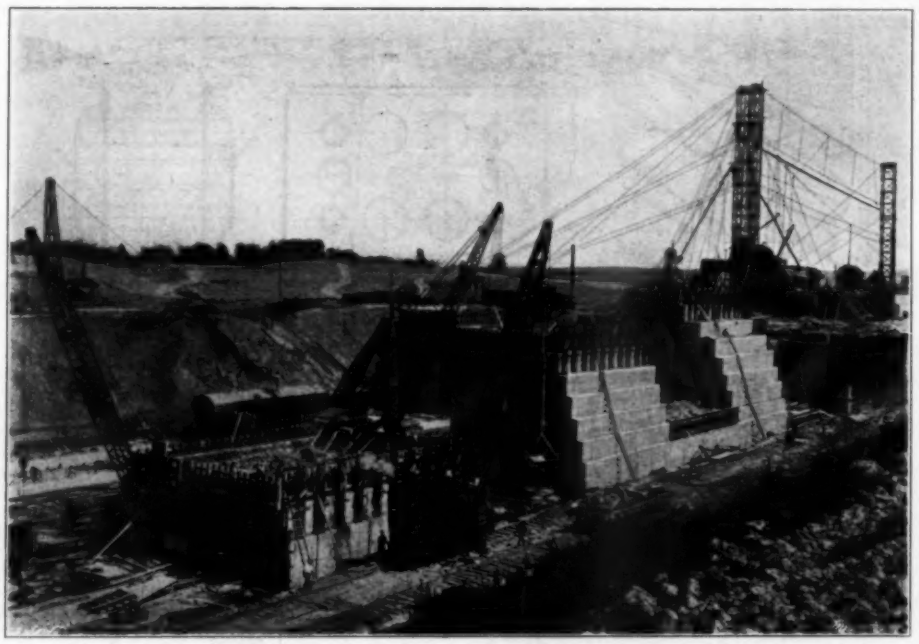

FIG. 2—LOCK NO. 2, LOOKING SOUTH

SIXTY YEARS AGO.

In February, 1865, Mr. John Walker, goldsmith and jeweller, of 68, Cornhill, London, received the unwelcome attentions of a gang of burglars, who broke open his safe and decamped with about £5000 worth of property. The burglary attracted great attention at the time and led to extensive developments in safe-making. So considerable was the interest that it aroused among the public in the matter of improved safes that even the chief of the burglarious gang, one Thomas Casely, took a hand in the discussion. Two years or so after he had committed the deed he wrote to Mr. Walker from Fremantle, Western Australia, offering him, by way of reparation, the design of a safe which, he claimed, would defy any burglarious attempt. Mr. Casely's original letter, a choice composition, is, we may add, to be found reprinted in our issue of August 23rd, 1867. We mention these facts merely for the purpose of acquainting the reader of to-day with the knowledge that sixty years ago public interest in safe construction was at a high level. Hence it came that Mr. Silas C. Herring, of New York, a safe manufacturer, was not content simply to exhibit a sample of his products at the Paris Exhibition of 1867. He felt constrained to issue a public challenge for stakes of 15,000f. to any other safe manufacturer who was exhibiting and who could establish that his safe could withstand fire or the attention of burglars more effectively than the Herring safe. The challenge was accepted by Mr. Samuel Chatwood, of Bolton, Lancashire. A committee of five was duly appointed to conduct the trial, namely, two Englishmen, of whom one, Mr. Robert Mallet, was THE ENGINEER's representative at the Exhibition; two Americans and an independent French chairman, together with a secretary. The fire tests do not appear to have been carried out. The tests simulating burglary were begun on August 13th, 1867, and were reported in our issue dated the 16th of that month. Mr. Herring set three powerful Germans to work to break open Mr. Chatwood's safe and to extract therefrom a wooden block about the size of a brick which the committee had deposited inside it. Simultaneously Mr. Chatwood set three Lancashire men on to Mr. Herring's safe to the same purpose. Some preliminary trouble arose as to the equipment which the Germans proposed to employ and certain parts of it were disqualified as not being such as a burglar would carry about with him. In the end the wooden block was removed from the Chatwood safe in 235 minutes. The Herring safe was broken open in 230 minutes to a sufficient extent to permit the extraction of any coins or jewellery that might have been within it, but because the block had been placed well to the back of the interior further work on it was required to fulfil the conditions of the test. The actual total time taken for the extraction of the block from the Herring safe was 254 minutes. The judges' decision was not immediately pronounced. The English members of the committee had to complain of certain irregularities with which they charged their American colleagues in connection with the drawing up of their reports. Eventually Mr. Mallet and his countrymen resigned and the chairman and secretary followed their lead. The committee thereupon ceased to exist and consequently no decision could be promulgated. One thing, however, emerged from the trials. Whoever purchased either type of safe was, according to the opinion of the day, assured of possessing a safe that was really a safe.

THE Board of Trade returns show that during the first half of the present year railway material of the following values was sent overseas, the corresponding figures for 1926 and 1925 are added in brackets:—Locomotives, £843,804 (£1,990,812, £1,738,212); rails, £1,193,207 (£1,143,706, £993,411); carriages, £1,712,491 (£1,125,050, £797,437); wagons, £1,091,633 (£1,743,908, £1,628,261); wheels and axles, £302,243 (£283,208, £296,509); tires and axles, £266,173 (£152,886, £224,411); chairs and metal sleepers, £534,663 (£561,625, £377,475); miscellaneous permanent way, £759,321 (£577,101, £676,245); total permanent way, £3,206,976 (£2,841,672, £2,644,433). The weight of the rails exported was 144,494 tons (146,797 tons, 103,953 tons) and of the chairs and metal sleepers 53,642 tons (57,931 tons, 32,549 tons). During the month of June last locomotives to the value of £73,643 were shipped, which included:—India, £22,930; South Africa, £13,717; Spain, £4000; Australia, £1440; and Ceylon, £1061. For June also the exports of rails were of the value of £300,783, and included:—India, £60,765; Argentine, £22,965; Portuguese East Africa, £15,509; Chili, £9810; Australia, £9757; South Africa, £9333; New Zealand, £3259.

The Westland Aircraft Works, Yeovil.

The Westland Aircraft Works, Yeovil, were established by Petters Ltd., during the war for the purpose of manufacturing aeroplanes for the Government. They were formed, to be precise, in 1915, under the management of Mr. R. A. Bruce, who continues to-day in the post of managing director. They are pleasantly situated on the outskirts of the Somerset-

FIG. 1—WESTLAND WORKS, YEOVIL, FROM THE AIR

shire town and directly adjoin the large aerodrome where the machines produced are tested. The old Nautilus Works, the original home of Petters Ltd., lie some distance away nearer the centre of Yeovil. They are now closed down, the whole of the firm's extensive oil-engine business having been transferred to the modern and roomy accommodation made available at the Westland establishment by the reduction of the aeronautical activity which set in after the war. In Fig. 1 we reproduce an aerial photograph of the Westland Works. On the left will be seen the railway which serves to supply the establishment with its raw materials, while to the right a portion of the aerodrome is shown.

The buildings are not divided on any rigorous plan between the aircraft and the oil-engine sides of the firm's business. While the aeroplane and the oil-engine erecting shops are quite distinct, the machine shops are common to both sections, and elsewhere as convenient, there is a harmonious and efficient correlation of the production facilities. We have said that the shops of the Westland establishment are roomy; in one instance, that of the aeroplane erecting shop, the provision made for the work in hand seems to the visitor to be excessive in one respect, namely, in the matter of head room. This department is housed in the tall building to be seen at the top of the aerial view. Its great height relatively to the size of the largest machines being produced to-day, is explained by the fact that at the time of its erection pressure from outside was exerted to secure its suitability for the manufacture of a particular type of large six-engined triplane, which at the time was thought to have great possibilities. The first and only example of the type that was built—not at Westland—crashed on its first attempted flight, with fatal results, and the design was abandoned. No doubt, should machines of a similar size be called for in the future the height of the Westland erecting shop will place the works in a favourable situation to undertake their construction.

Like most other British aeronautical firms, the Westland Works are paying close attention to the development of metal aircraft. The establishment, however, is not as yet wholly wedded to the all-metal machine, although it is fully equipped to produce it, either in steel or light alloy. Those responsible for the technical policy of the works hold that the metal construction of aeroplanes is a subject which must be approached with considerable caution from the manufacturing point of view. The designer, it is argued, must not allow the idea of using metal to become a fetish to the exclusion of other materials, and to lead him into unpractical methods of construction. While the main framework of the machine may well be of metal there are still, it is believed, a number of parts for which it may pay to use wood or other material. A vital factor in determining whether a given part should be made of metal or otherwise is, the firm holds, the number in which such part is required. Unless the quantity is considerable, it may be unprofitable to produce the part in metal. From a manufacturing point of view, it is stated, the most satisfactory solution of the problem, at the present time, would appear to be a compromise between the two systems of construction. A good deal of experience has been gained by the Westland Works in the building of composite types of aeroplane. Among the machines of this description which the establishment has produced are aeroplanes with metal wings and wooden fuselages, others with metal fuselages and wooden wings, others again with composite metal and wooden fuselages, and yet others with wooden wing frames built upon main spars of metal.

In addition to problems of design and of commercial production, metal aeroplane construction presents many problems of manufacture with certain of which we have dealt on a former occasion—see The Engineer for November 3rd, 1922, and also for March 12th, 1926. The problems which arise in this connection result from the thinness of the material handled: its, at times, intractable nature, and the difficulties of devising the tools required to give it the sectional shapes specified by the designer. The Westland Works have done a good deal of development work leading to the solution of these problems, and are now equipped with plant for the production of the desired sections, either by drawing or by rolling—as best meets the case—from strip or sheet steel or light alloy.

As an example of the firm's system of metal construction, we illustrate in Figs. 2 and 3, and 11 and 12, page 204, the arrangement and details of the metal—principally steel—framework of the wings of a Westland D.H. 9A biplane. It should be stated that while the design illustrated is typical of the firm's practice, it is not wholly representative of its most recent work, which work cannot for the time being be described. The spars—as shown in Fig. 3—are built up of four corrugated strips riveted together along their turned-out edges. The material used is high tensile steel 0·015in. thick for the web strips and 0·022in. thick for the flange strips. At intervals of about 10in. flanged rectangular stiffening plates are riveted in the interior of the spar. The application to a spar of this description of a relatively heavy concentrated load, as, for example, that applied to it at the end of an interplane strut, requires precautions to be taken to prevent local failure. The method adopted by the Westland Works is illustrated in Figs. 2 and 12. As shown in Fig. 2 the webs are stiffened against local collapse by means of a distance piece between them consisting of two flat plates, to which five short lengths of tubing are spot welded. The plates are riveted along their edges to the webs, the rivets also serving to fix in position two external plates fitting over the corrugations in the webs. To this locally strengthened part of the spar a saddle plate is applied—as shown in Fig. 12—the saddle plate being formed with a rib to which the interplane strut end is pinned, and being fixed to the spar by five bolts passing through the tubes of the spar distance piece. The saddle plate also carries fittings for the attachment of the diagonal stay wires and for a drag strut running horizontally from the front to the rear spar.

The general assembly of the wing framework is illustrated in Fig. 3. The spars are held apart by six tubular drag struts with two similar additional compression tubes to take the reaction applied by the aileron controls. The form is maintained by means of diagonal interspar tie rods. The ribs are built up of channel sectioned steel strip, with flat steel strips for the diagonal bracing. They are riveted to the spars and the leading edge and are riveted and wired to the trailing edge. The trailing edge consists of a flattened, open-jointed tube, and the leading edge of a trough section with the edges curled inwards. Between the leading edge and the front spar three false ribs are riveted in position intermediately of each pair of ribs. Over the first three panels nearest the root, or fuselage end of the wing the leading edge is protected by a plate of 22 gauge aluminium folded back, top and bottom on to the front spar. The leading edge near the wing tip and the trailing edge near the root are curved or bent. At these points of change of direction the edge members are not continuous. The curved or bent portions are separate elements, and are united to the straight portions by means of rivets passing through solid blocks of aluminium filling the abutting ends.

It will be seen that in the construction of metal aeroplanes, as exemplified by this wing framework, riveting plays a very prominent part. In one spar alone the number of rivets used may run into thousands, and consequently it is very necessary to design the parts in such a way as to avoid placing rivets in positions in which access to them is awkward. In the production of the spars described above, the flange and web strips are placed in a long jig and the holes

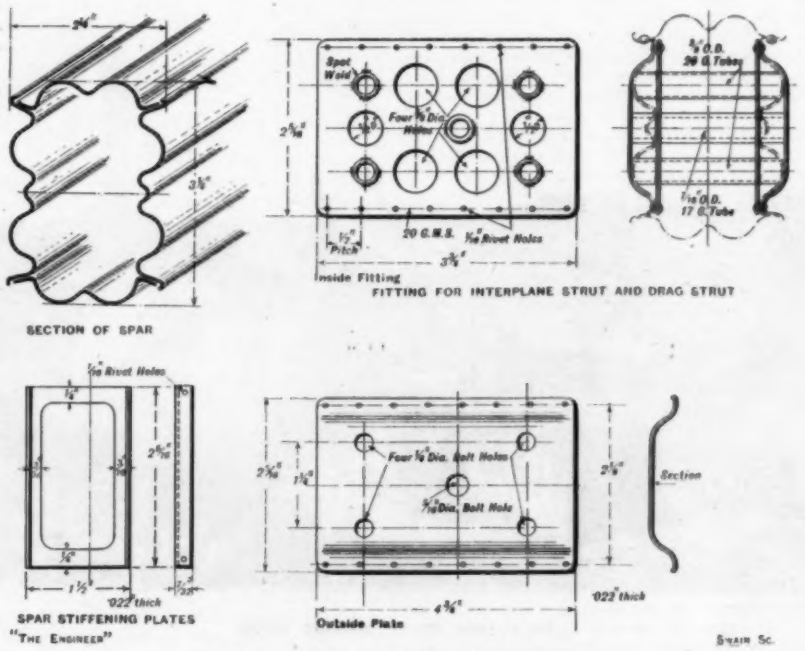

FIG. 2—DETAILS OF SPARS AND STRUTS

are punched in them by means of a small hydro-pneumatic punching tool, weighing only a few pounds, which can be easily moved along the spar by the operator. Attachments on the tool regulate the distance between the rivet holes and their distance from the edge of the flange. The rivets, after being dropped into position, are closed by means of a pneumatic riveter employing a squeezing action. Both the punch and the riveter, like most of the other metal working tools employed, were designed and made by the firm itself. Percussion riveters are unsuitable for this class of work, for with the thin metal used, a false blow might readily ruin a spar,

representing many pounds in labour and material. In addition, the small thickness of metal holding the rivets does not support them adequately against turning over sideways when blows are struck on them to form the head. The squeezing action of the riveter employed gets over this sufficiently, and, in addition, the method enables the movement of the snaps to be stopped automatically when they are just the thickness of the metal apart, so securing the satisfactory closing of the rivets without danger of the snaps biting into and damaging the metal of the parts being fastened together.

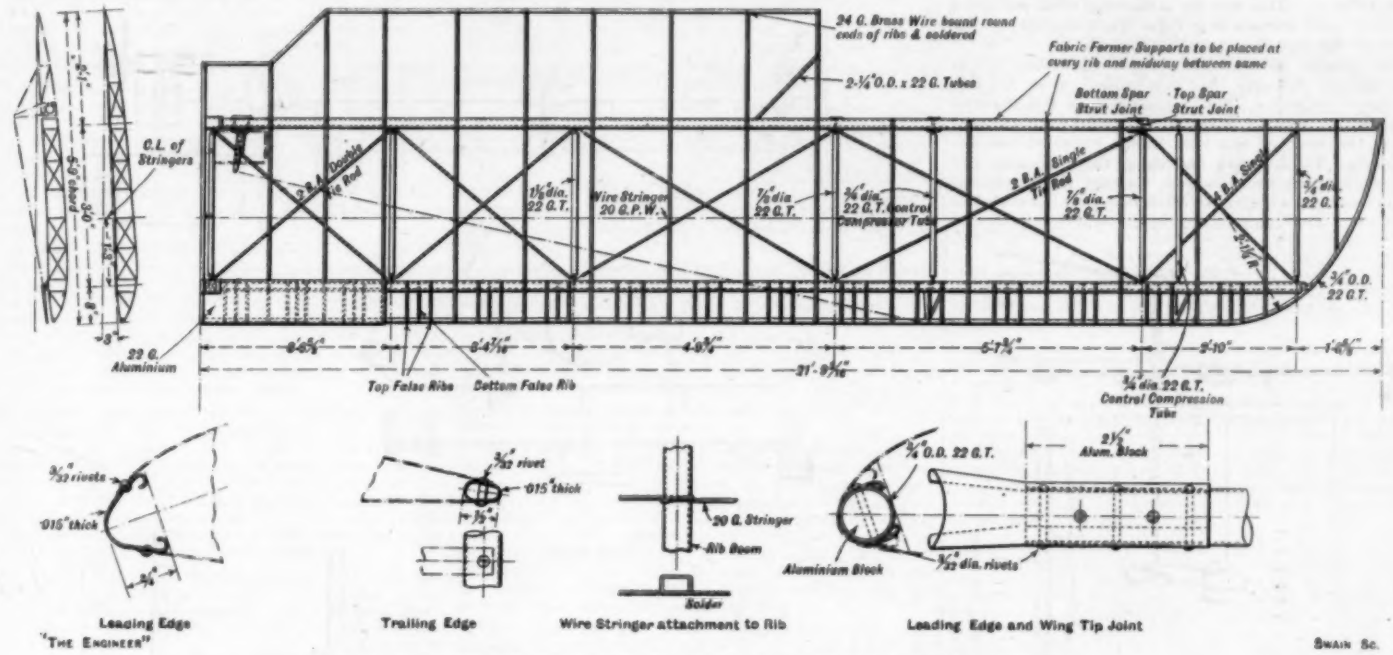
24 G. Brass Wire bound round ends of ribs & soldered
Fabric Former Supports to be placed at every rib and midway between same
2-¼"O.D. x 22 G. Tubes
Bottom Spar Strut Joint
Top Spar Strut Joint
C.L. of Stringers
22 G. Aluminium
Top False Rib
Bottom False Rib
¾" dia. 22 G.T. Control Compression Tube
Leading Edge
Trailing Edge
Wire Stringer attachment to Rib
Leading Edge and Wing Tip Joint
"THE ENGINEER"
SWAIN Sc.

FIG. 3—ARRANGEMENT AND DETAILS OF WING OF A WESTLAND D.H. 9 A BIPLANE

clear height of 20ft. It lies parallel with one of the longer sides of the building, and measured at the lowest point of the outlet end is 9ft. above the floor level. All these dimensions are of importance, for the reason that in a confined space the air returning from the outlet to the inlet end of a wind channel may have a relatively high velocity, and as a consequence may develop eddies which are much better avoided. The ideal arrangement is to draw the current into the channel from a volume of still air. At the Westland Works that result is substantially secured, as may be judged from the fact that the workers in the building housing the channel—it is used as the wing-assembling shop—do not notice any draught when the channel is in use. At the side of the channel there is an enclosed platform for the operator, with an office underneath. Even these obstructions, it is said, do not interfere with the flow of the returning air. At the inlet end there is a faired entrance to prevent eddies being formed as the air is drawn into the channel. As an additional pre-

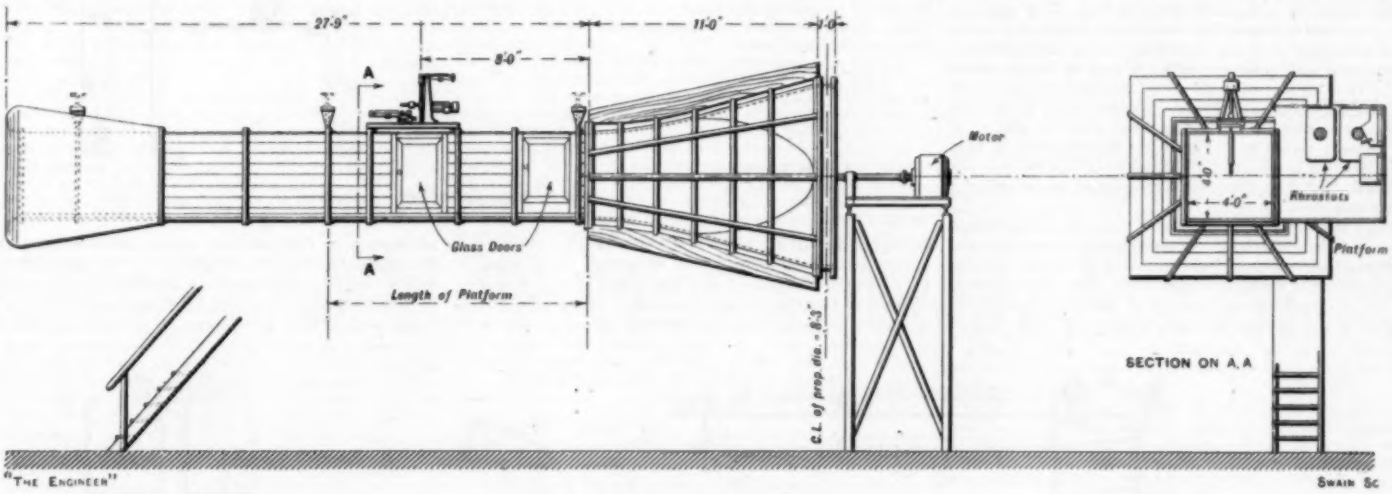

FIG. 4—EXPERIMENTAL WIND CHANNEL

The general equipment and arrangement of the factory follows modern and familiar lines. We will therefore omit a detailed description of the wood-working department, the wing-covering shop, the painting and doping, the fitting and erecting shops, and other sections, and will pass on to describe the firm's equipment for conducting model experiments. This equipment consists of a 4ft. wind channel erected three years ago, and is modelled on the designs in use at the National Physical Laboratory and the Royal Aircraft Establishment. With the exception of the electrical gear, the air-screw providing the current of air, the glassware of the instruments and the standard weights used on the balances, all the equipment was designed and made at the Westland Works. The arrangement of the wind channel is shown in Fig. 4, and side and end views in Figs. 9, 10, and 13.

The working section of the channel is 4ft. square, and through it air is drawn by a four-bladed air-screw, 8ft. 3in. in diameter, working in a cylindrical portion at the outlet and 8ft. 6in. in diameter. The air-screw is driven by a 25 horse-power direct-current motor, and is capable of producing air speeds up to 70ft. per second. Two rheostats, one for coarse adjustment and the other for fine, control the speed of the motor and regulate the air speed over the working range. Power is obtained from Messrs. Petters' private power station, and no trouble whatever has, we are informed, been experienced in obtaining constant speeds over the short periods absorbed by an ordinary test. As shown in Fig. 10, the air-screw and motor are

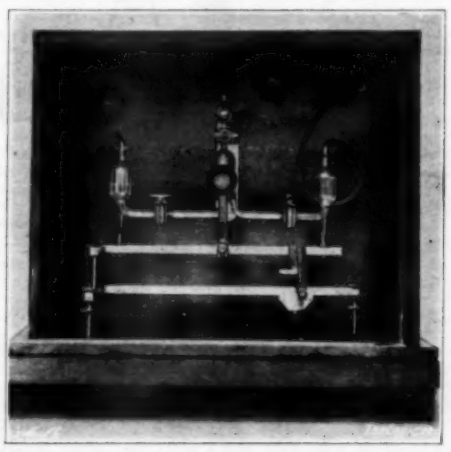

FIG. 5—CHATTOCK MANOMETER

caution, a honeycomb made up of cells 4in. by 4in. in section and 18in. long is fitted just inside the entrance.

The speed of the air through the channel is measured by means of a Chattock manometer—Fig. 5. One limb of this manometer is open to the atmosphere of the building, and the other is connected to a suction plate in the wall of the wind channel situated about 6ft. upstream of the point at which the model is tested. The differences of pressure recorded by the manometer are not employed as a basis for the calculation of the speed of the air in the channel. The relationship is determined experimentally by measuring the head at the suction plate and comparing it with the simultaneous value of the air speed as measured by means of a pitot tube and static head placed in the position subsequently to be occupied by the model under test. The manometer readings, following this calibration, give the true speed of the air immediately in contact with the model.

The actual portion of the channel in which the experiments are conducted is situated about 20ft. from the inlet end. Access to and inspection of the model under test is provided by means of two glass doors. The aerodynamic forces are measured on two balances, which were made in the tool-room of the Westland Works. The design of the balances follows that of a type suggested by the Royal Aircraft Establishment. The diagram—Fig. 6—illustrates the action of the balances when experiments for the determination of lift and drag are being carried out. The model is placed in the channel horizontally, but inverted, so that the "lift" becomes a force

acting vertically downwards, while the drag remains as a force acting from left to right. At the front end the model is supported by two fine steel wires depending from an auxiliary balance. At the rear end, it is supported by a spindle projecting downwards through the top wall of the channel and depending from the main balance. This spindle is shielded from the wind by a tapered stream line tube fixed rigidly to the channel, but not shown in the diagram.

The greater part of the downward acting lift is transmitted through the suspending wires to the auxiliary balance. The remainder is transmitted through the spindle to the main balance. The total lift is the sum of the two forces recorded on the balances. To measure the drag, the auxiliary lift is locked in its mid-position, leaving the model to swing freely in a horizontal direction parallel with the air flow. The main balance, as will be gathered

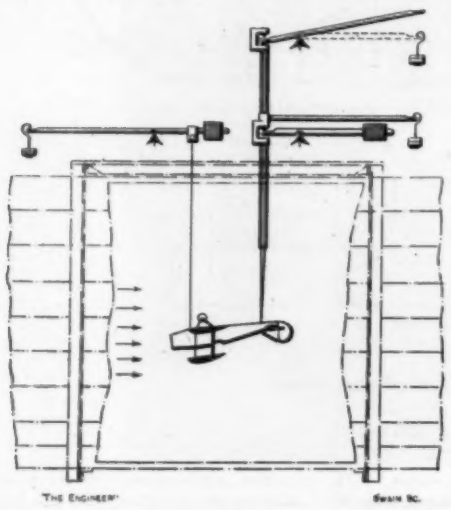

FIG. 6—DIAGRAM ILLUSTRATING ACTION OF BALANCE

presently, can be set to measure either vertical or horizontal forces.

The balances are illustrated in Figs. 7, 8 and 14. The auxiliary balance, Fig. 8, is in the form of a steelyard, mounted on a carriage that can be adjusted and clamped in any position along a pair of longitudinal rails. It is equipped with an oil dashpot to damp out oscillations, and, as already stated, with a locking device, whereby the swinging arm may be locked in the central position. The wire attachment is provided with a graduated winding drum to permit the model to be tilted through any desired angle about a transverse axis.

The main balance—Fig. 7—is of a somewhat more elaborate design. It consists of a vertical rod supported on cup and cone pivots A B at the ends of two horizontal rocking arms C D. The lower arm C carries a counterpoise, which is set to balance the weight of the equipment and the model. The upper arm D is used to measure that portion of the "lift" transmitted on to the main balance. The measurement is effected by means of weights hung on the end of the arm and by a rider weight which may be adjusted along the arm through the agency of a screw mechanism.

It will be gathered that in experiments for the determination of lift, the force derived from the model is applied vertically at the end of the arm D, the floatation of the system being obtained from the support provided by the arm C. In experiments for the determination of drag the force derived from the model is applied horizontally at the lower end of the vertical supporting rod. To measure this force, the upper arm D is thrown out of action by tipping it by means of the cam E and the lower arm C is locked in its mid position, also by a cam. An arm F, which is rigidly attached to the vertical rod, now forms in conjunction with that rod a ball crank lever pivoted at the point A. Weights and a rider on the arm F therefore permit the horizontal drag force to be measured. Great care has to be taken to ensure that the balances are set correctly to measure the drag and lift forces in directions truly parallel with and perpendicular to the air flow. The drag of an aerofoil is frequently less than the twentieth part of its lift, and as a consequence a very small angular error in the direction of the axes may lead to very large errors in the measured drag force.

When it is required to measure moments, such as the pitching moment of an aeroplane about its centre of gravity or the moment of a control surface about its hinges, pivots are arranged in the channel on an axis which is such that the moments can be measured by transmitting a vertical force to one or other of the balances. When side forces or yawing moments are to be measured, the same procedure is followed, with the exception that the model is rotated about its longitudinal axis through 90 deg., so that its span is vertical.

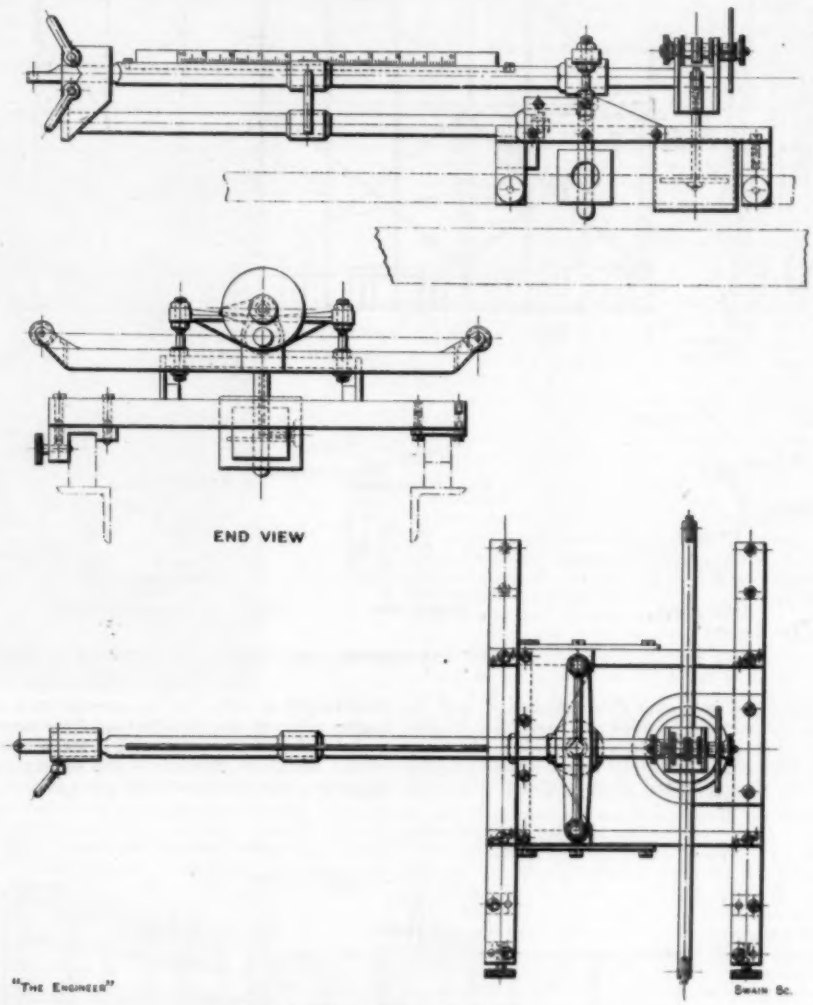

FIG. 8—THE AUXILIARY BALANCE

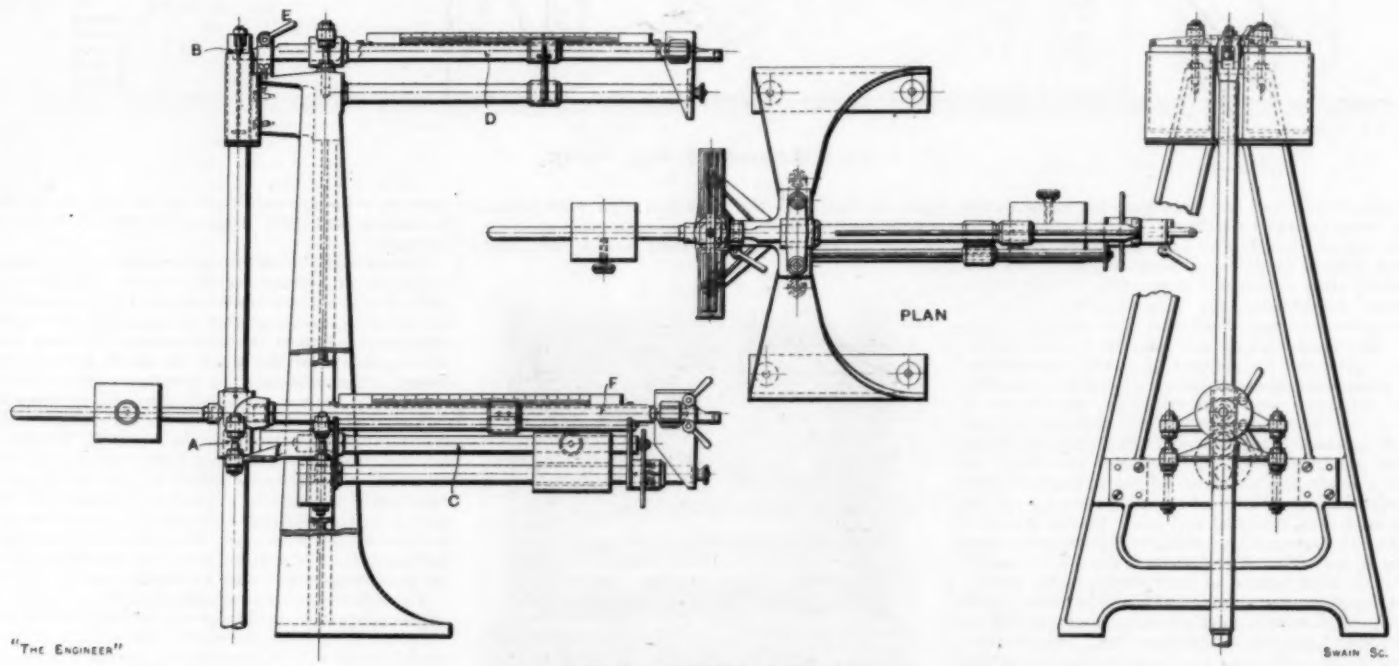

FIG. 7—THE MAIN BALANCE

It is said that a large coalfield has been discovered 50 miles to the west of the Copper Queen mine, Rhodesia.

Railway Matters.

THE London and North-Eastern Railway has revived the competition the old North-Eastern had of giving awards for the best maintained lengths of track. The best inspector's division is to have a cup from the directors and a gold medal, whilst the best ganger's length on the whole line is to have a cup from the engineer and a gold medal for the ganger and a silver medal for each platelayer.

UP to the end of 1926, 585 miles of main line railways and 70 miles of suburban lines had been electrified in Germany. Of the main lines, 275 miles are in Bavaria, and of the suburban lines 50 miles are in the Berlin area. At the present time 190 miles of line are in course of electrification, including the Konigszell–Breslau mountain railway, 30 miles; the Munich–Rosenheim–Kufstein line, 62 miles; and about 100 miles of the Berlin city and local railways.

IN view of the frequent references just now to the American Railway Centenary Exhibition at Baltimore, it should be noted that in contrast to the centenary celebrated in July, 1925, of the opening of our Stockton and Darlington, the event about to be commemorated in America is only the granting of a charter for a railway that subsequently became a section of the Baltimore and Ohio Railway. The centenary of the opening of that line cannot be celebrated until April, 1830.

THE exterior painting of the Great Western carriages is being modified. The upper portion is now of cream throughout, and the lower portion brown, and there are no dividing panels. The change is to suit modern methods of painting, and thereby get the work done in less time. We agree with the *Great Western Railway Magazine* that "the changed appearance is, at first, to some people rather displeasing," but perhaps we shall later also agree "that its simplicity and boldness are attractive."

THE London and North-Eastern Railway has made the official announcement that in order to meet the public need for more intensive passenger services, tests have been made with the Sentinel-Cammell and the Clayton type of steam rail cars, and as a result orders have been placed for twenty units of the Sentinel-Cammell type, and for four Super-Sentinel locomotives. It is added that it is intended to order thirty further units, of either the Sentinel-Cammell or the Clayton type, but that has been deferred pending further experience of certain mechanical improvements.

IN the current issue of the *Great Western Railway Magazine* Sir Felix Pole, the general manager, refers to the number of suggestions and inventions which have been submitted by employees and adopted by the company under its Suggestions Scheme. The figures for the year ended March 31st last show that 3525 suggestions, which included some brought forward from the previous year, were dealt with, of which 15·17 per cent. were adopted, compared with 15·50 per cent. in the previous year. Although the number of suggestions was slightly lower, the general standard was somewhat higher, and an increased sum of money was distributed in monetary awards. The suggestions embraced traffic arrangements, mechanical and engineering appliances, signalling and signalling appliances, as well as a miscellaneous group. Since the scheme was put into force in 1913 no less than 29,698 suggestions have been submitted to the Committee.

As recorded in this column on March 4th last, there was a collision the preceding Sunday evening at Penistone on the Great Central Railway. Lieut.-Colonel Mount inquired into the case and his report thereon has recently been issued. From that document we learn that a light engine which had brought a London, Midland and Scottish train from Huddersfield had been to the engine turntable to turn, and had then been admitted on to the up main line in advance of the trailing points, in that line, of the junction with the Huddersfield line. The engine should then have been backed along the up main, through the trailing points and over the line from Huddersfield to the other end of the station, where it would have been crossed on to the line to Huddersfield. Unfortunately, the signalman failed to set the trailing points for the right direction, and so the engine set back towards Manchester. The driver wondered why such a movement had been made, so stopped and whistled. The signal in front of him was then lowered, and he had just reversed and given his engine steam when it was run into by an express from Manchester. The signalman did not know of his omission, and did not see the light engine, and so he accepted the express. A signal for the setting-back movement in question, which will guarantee that the points are correctly in position, is recommended.

IN our issue of July 22nd we illustrated and described some coaches that had been constructed by the London, Midland and Scottish Railway as L.M.S. and L.N.E. joint stock sleeping saloons. As the term "joint stock" may need some explanation, we would say that when a vehicle runs on a length of line belonging to some other railway than that of the owning company, the latter is entitled to certain payments for the use of the vehicle—the company owning the railway gets the charges for carriage. Such matters are adjusted through the Railway Clearing House. For regular services, *e.g.*, services between the London and North-Eastern and the Great Western or the Southern and the Great Western, one of the two companies concerned provides the coaches for three days out of the six and the other company for the other three days, and so the workings are balanced. An older arrangement was the provision of jointly owned stock, which was paid for in proportions equivalent to the mileage of the route over which the carriages run. Thus, if the sleeping saloons ran, as we expect, between St. Pancras and Edinburgh, the ownership would be as about 75 per cent. for the L.M. and S., and 25 per cent. for the L. and N.E. The first jointly owned stock was that of the London and North-Western and Caledonian; another lot was that of the three companies running between King's Cross and Edinburgh. The former was labelled W.C.J.S. and the latter E.C.J.S., which signs have no doubt often raised curiosity. It is significant that the saloon in our illustration of July 22nd bears the original lettering of "M. & N.B."—Midland and North British.

Notes and Memoranda.

A SHORT time ago the French Fédération de la Mécanique set up a special Commission to draft reports for the standardisation of everything as much as possible in machine construction. The French Comité des Forges has also appointed a similar Commission, which is to approach standardising bodies in other European countries, especially in Germany, with a view of establishing common standards in the iron and steel industries.

THE broadcasting station at Bremen has been transmitting for some weeks on a wave length of 252·1 m.—1190 kc. This, however, is only an experimental wave length, and, according to reports, has not been found very favourable for reception by the majority of listeners to this station. It is probable, therefore, that this wave length will not be permanently adopted. It will be remembered that the previous wave length used by Bremen was 400 m.

A SERIOUS explosion resulting in two deaths is reported by the *Chemiker-Zeitung* to have been caused at Seelze, near Hannover, on May 26th, by the grinding of lead bromate in a mortar. The salt, which hitherto had been prepared from lead carbonate and bromic acid, was on this occasion precipitated from solutions of potassium bromate and lead acetate, and had been well washed on a filter and dried in the oven at 70 deg.–80 deg. Cent. Grinding 1 kgm. of it in a mortar caused a very violent explosion and considerable damage was done.

VISITS to some of the farms on which pioneer work is being done in electrification, states our American contemporary, the *Electrical World*, bring to light the very definite fact that the farmer still possesses his traditional abhorrence for spending money and is perfectly willing to get along with makeshifts. His principal objection to rural electrification is cost. He has to make a large cash expenditure in order to get the service and usually makes the most of his opportunity to economise in the purchase of equipment and distribution lay-out.

THE Société de l'Union d'Electricité of Paris is now augmenting its electricity supply in the Paris district by power transmitted from the Eguzon hydro-electric station, completed last year. The large steam-operated station at Gennevilliers, near Paris, has now a capacity of 340,000 kilowatts. Last year the electrical output of the Union company amounted to 749,000,000 units, as against only 671,000,000 units in 1925. Part of the increase is explained by the fact that the Union Company is now supplying energy for all the electrified lines of the Paris-Orleans railroad.

A NEW photo-cell which is being made by an entirely different process from that usually employed in the manufacture of these cells possesses performance characteristics of unusual interest. The bulb, containing only a small tungsten filament, is evacuated for hours at a high temperature with mercury diffusion pumps and liquid air traps. The tube is then sealed off. It resembles an ordinary electric lamp bulb. The photo-electric metal is introduced into this highly evacuated bulb by a special process of electrolysis directly through the glass wall of the bulb. The result is a silvery coat of the purest photo-electric material. Since the cell works by a pure electric discharge there can be no question of the quickness of its response. In all probability its speed is limited only by the capacity and inductance of the tube to short wave radio frequencies.

THERE has been more research work done on electroplating solutions and processes from 1917 to the present time than in all the previous years combined. At government laboratories, universities and commercial plants many important investigations have been brought to a successful conclusion. Previous to this time the investigator was handicapped by the dearth of any reliable data. To-day there are many papers in the publications of societies and in scientific and trade journals, that contain accurate information. Two books, one in England and the other in America, have recently been published, and while neither is thoroughly scientific, they both have for their object the education of the electroplater and the necessary instruction for the scientist concerning commercial practice, and have suggested methods for making and controlling plating solutions.

HAVING regard to the potential importance of the Nipah palm as a source of power-alcohol in view of the Singapore Base, some observations contained in the annual report for 1926 of the Chief Secretary to the Government, Federated Malay States, are of especial interest. There are, the report states, two existing estates in Selangor with a planted area of over 900 acres varying in age from a year to nearly four years. The growth is reported to be excellent, and the older palms are already fruiting. The Department of Agriculture has records of yields taken over a period of two years from some palms eight to nine years old, growing in conditions less favourable than those on estates. These records show that very high yields of 1000 gallons of alcohol per acre per annum are quite probable, and if such difficulties as those of maintaining an adequate tapping force and of finding a stable and satisfactory market can be overcome, prospects would appear to be very good.

INTERCONNECTION of transmission systems, states the *Electrical World*, has a commercial value not readily computed in terms of capacity saved or as a physical precaution against service interruption. Its psychological effect, however, may be very great. Recently a large industrial power user contracted for 20,000 kilowatts of maximum demand. This industrial plant had previously declined to consider purchased power, although negotiations had been carried on for a number of years. When, however, the power company effected an interconnection with another station, involving a cost of 350,000 dollars, the contract to supply the industrial plant with 20,000 kilowatts was closed, as the customer felt that he now had sufficient assurance of service continuity. Since the interconnection was effected, nearly two years ago, power has been transmitted over it only once, and then into the other system. But the customer knows that the connection is available and that another power supply can be drawn upon if occasion arises.

Miscellanea.

IT is proposed to utilise the waters of the Grose River and its tributaries, New South Wales, for the generation of electric power.

OUT of a total of 15,511,438 units sold by the Wimbledon electricity supply undertaking in the year ended March 31st, no fewer than 7,215,001 were used for heating and cooking. In 1924 the cooking and heating units were 1,928,584; in 1925, 3,045,722; in 1926, 4,526,588; and in 1927, 7,215,001. Thus the increase in the past year over the previous year was 2,694,413 units, or 46·51 per cent.

ACCORDING to figures just issued by the Postmaster-General, Great Britain possesses 1,500,000 telephones. This is only 5 per cent. of the world's telephone total, which, allowing for a normal rate of increase since the last world survey, numbers in round figures 30,000,000. The share of the whole of Europe—nearly 8,000,000—is only about 27 per cent. of the total, while the United States, with some 18,000,000, has 61 per cent. This leaves only 12 per cent., or about 3,600,000, between the other countries of the world.

ACCORDING to the *Industrial Australian*, Mr. Purvis, chairman of the Sydney Water Board, has reported on the scheme of the late Mr. W. T. Keele for supplying Sydney with water from a dam at the source of the Snowy River, and to also provide 21,000 kilowatts of electric power *en route*. Mr. Purvis estimated the cost of the scheme at £42,000,000. He recommended an alternative scheme to bring 200,000,000 gallons of water daily from the Warragamba basin, which would also supply 5000 kilowatts of electric power, at a total cost of £12,000,000. This scheme would take six years to complete.

IN its monthly report the National Federation of Iron and Steel Manufacturers states that the number of furnaces in blast at the end of July was 174, a net decrease of two since the beginning of the month. Production of pig iron in July amounted to 645,800 tons, compared with 651,300 tons in June and 720,100 tons in May. The production includes 214,000 tons of hematite, 213,000 tons of basic, 165,900 tons of foundry, and 23,000 tons of forge pig iron. The production of steel ingots and castings amounted to 682,900 tons in July, compared with 747,300 tons in June and 884,600 tons in May.

AT last the undertaking known officially as the Post Office (London) Railway is to be opened for service. Its sole function is the conveyance of mails. The tunnel is too small to accommodate carriages in which a passenger could stand up, and no drivers will travel with the trains, which are electrically driven and are controlled from the stations, where the tunnel is enlarged. The line extends from Paddington to Whitechapel, a distance of about 6 miles, and there are stations under the principal post offices on the way. The loading and unloading of mails at stations is largely automatic. It is expected that more than a quarter of the mail vans now running east and west on London streets will disappear after the railway begins operation.

THE third unit in the Chelsea, Quebec, power house of Gatineau Power Company has been started, and is supplying power to the Gatineau mill of Canadian International Paper Company, now nearing completion. The first unit at Chelsea was turned over on January 4th, one year and seventy-seven days from the commencement of construction, and the second unit was put in operation on January 29th. All three units as well as one unit in the Farmer's hydro-electric plant of the company, 7000ft. below Chelsea, are furnishing power to the Gatineau mill. The Chelsea development is on the Gatineau River, 7 miles from the city of Ottawa. The power house is designed for five units of 34,000 horse-power each, and will operate under a head of 96ft.

IT is proposed to install another 40,000-kilowatts of plant in the Hackney power station. The chief engineer, Mr. Robinson, estimates his total costs per kelvin delivered to feeders at 0·253d. This covers fixed operating costs of 0·105d. and running costs of 0·148d. With a 33⅓ per cent. load factor and coal at 20s. the cost at the feeder terminals would be £2 6s. 10d. per kVA per annum, and the energy costs would be 0·148d., as stated. Exceptionally low costs per kilowatt are quoted for the new station. During the first stage the kilowatt will cost £13·5, and for the completed station it will be only £12·8. Unless the Council can be supplied from outside sources at no more than these figures there is no reason why the proposed extensions should not be carried out.

A SECOND six-wheeled omnibus was put into service by the London General Omnibus Company on Sunday last. This omnibus—L.S. 2—resembles L.S. 1 in general form, but with the experience gained by the operation of the original vehicle, it has been possible to introduce several new features which will provide additional comfort. For example, the platform area has been increased 11in. in width. The staircase is 3in. wider. The overall length is now 29ft. 5½in., compared with 29ft. 1½in. of L.S. 1, and the seating capacity has been reduced from sixty-eight to sixty-six, thus allowing more freedom of movement for passengers. The body is of aluminium and duralumin, instead of steel. There are seats for thirty passengers on the lower deck and thirty-six on the upper. The upper deck is covered in.

THE management of the heavy section of the British Industries Fair reports that the space definitely booked for the 1928 display in Birmingham is some 5400 square feet in excess of the total space occupied by the entire exhibition in that city last February. This position, attained a full six months prior to the opening, constitutes a new record in the history of the Fair. It is the more remarkable in view of the great extensions, totalling 120,000 square feet, at a cost of £30,000, which were carried out for the 1927 Fair, when, notwithstanding this increase of area, every available foot was occupied. The Birmingham authorities note with special satisfaction that 93 per cent. of exhibitors of last February have again booked their positions, no fewer than 178 firms having applied for larger space, chiefly for the purpose of additional working exhibits.

THE WESTLAND AIRCRAFT WORKS

PETTERS LTD., YEOVIL, ENGINEERS

(*For description see page* 200)

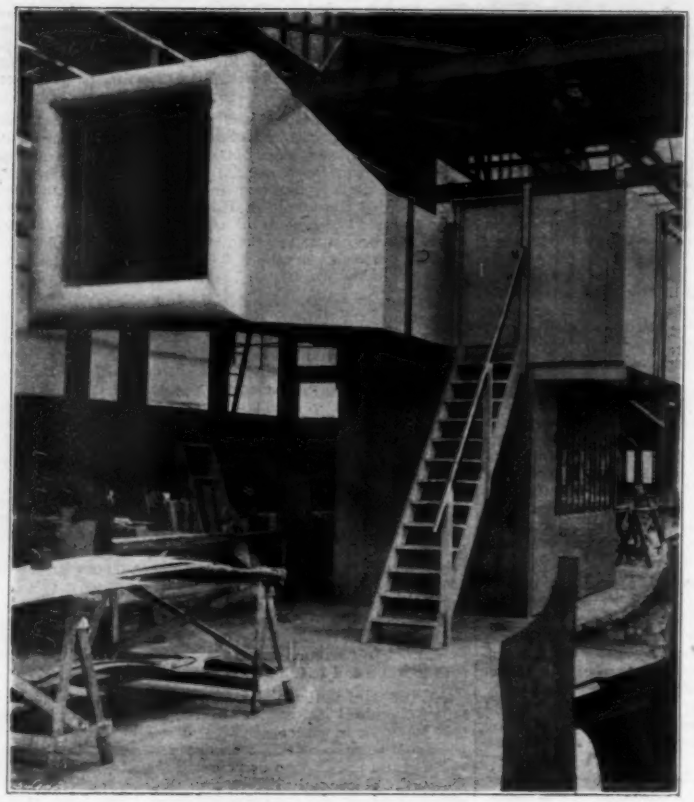

FIG. 9—INLET END OF WIND CHANNEL

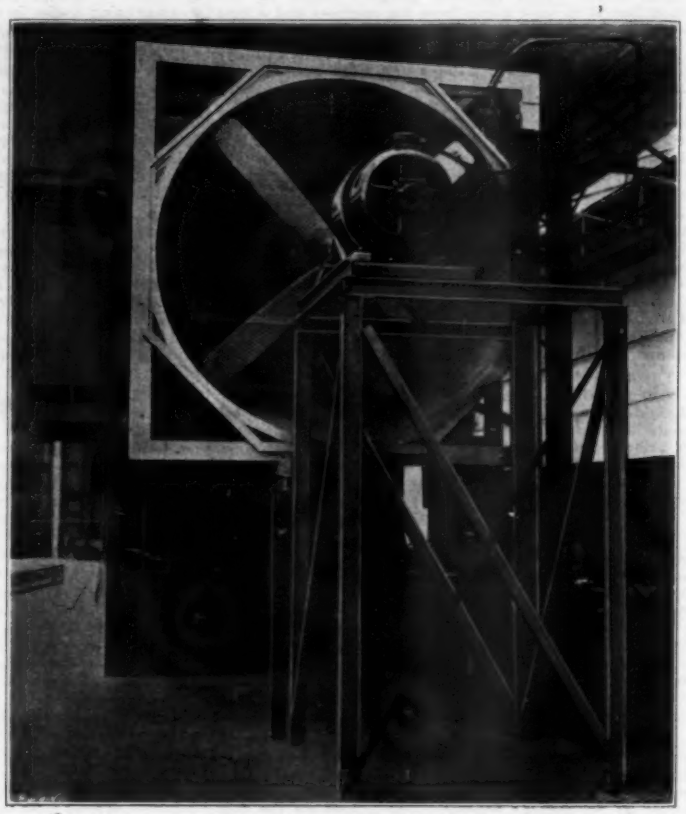

FIG. 10—OUTLET END OF WIND CHANNEL

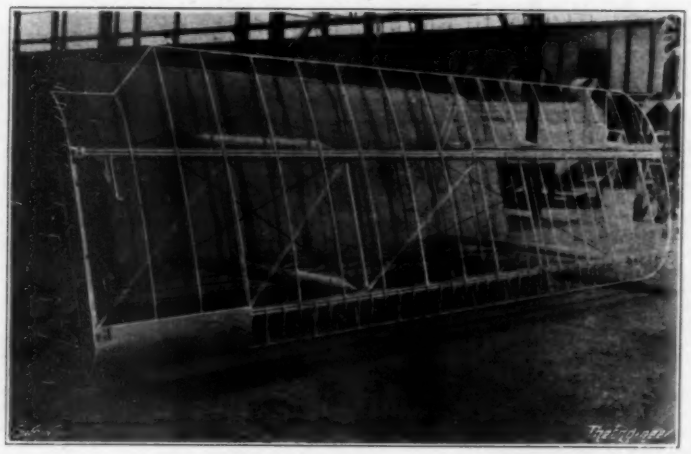

FIG. 11—METAL FRAMEWORK FOR WING OF D.H. 9A BIPLANE

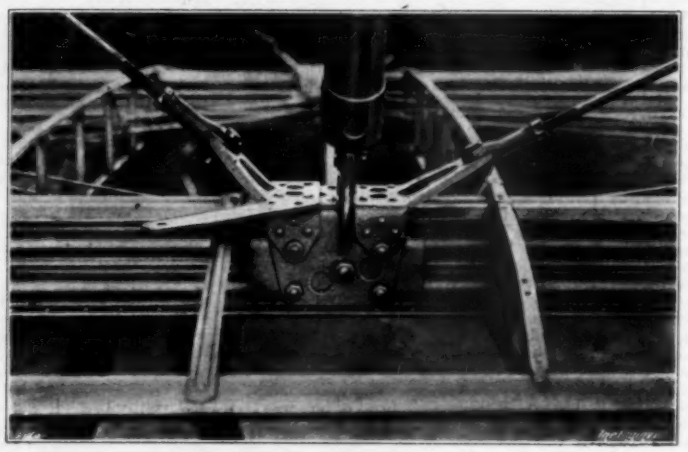

FIG. 12—INTERPLANE STRUT JOINT TO MAIN SPAR

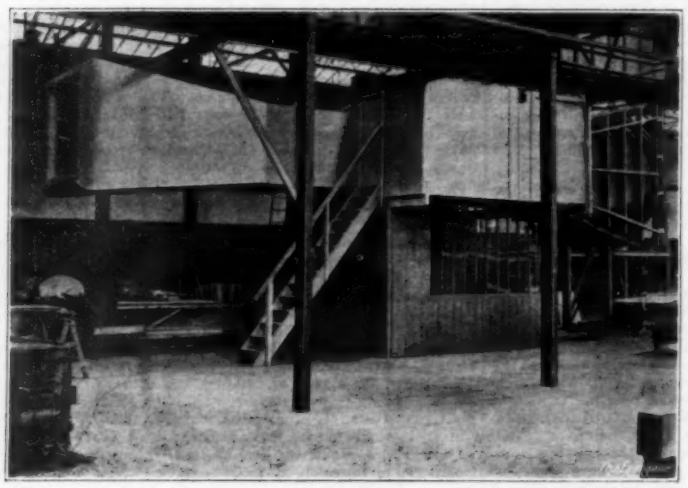

FIG. 13—GENERAL VIEW OF WIND CHANNEL

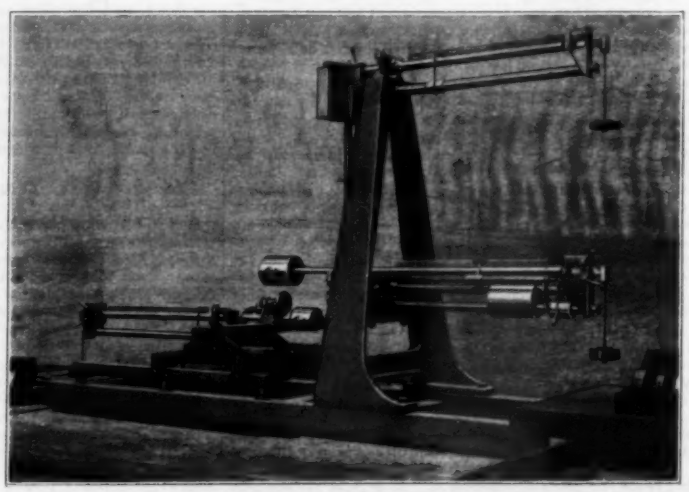

FIG. 14—SIDE VIEW OF ROOF BALANCES

The Engineer

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DEATH.

CROSSLEY, NEVILL M.—Many of our advertisers will share our deep regret at the death of Mr. Crossley, which took place at a nursing home on Wednesday last following an operation. Mr. Crossley had been on the advertisement staff of THE ENGINEER for nearly twenty-five years.

THE ENGINEER.

AUGUST 19, 1927.

Power Stations and Carbide Manufacture.

IT is one of the grievances of power station engineers that the demand for electricity is far from uniform. Their plant has to be kept in operation twenty-four hours per day, winter and summer, and wages are going on continuously. Much more important than this, the costly machinery and cables necessary to deal with the peak loads of the winter are lying idle half the time, earning nothing and leaving their capital charges to be paid by the consumers generally. Such a state of affairs is obviously unfavourable to the supply of cheap electricity, and many are the efforts made to combat it. The encouragement by means of special tariffs of long-hour users, or of those who restrict their demand to times of light load, is one method. Campaigns in favour of the use of domestic heating, cooking, and other current-using devices, coupled with facilities for the hire or purchase of the necessary appliances is another. Even the small possibilities which lie in the charging of the batteries of electric vehicles by night have not been neglected. All these attempts to improve the load factor of central stations depend, however, on engaging the interests or the goodwill of the consumers. The appeals have to be widespread and insistent, and even then the load is obtained painfully and almost unit by unit. There is, moreover, a limit to what can be effected in these directions. A power plant serving a mainly residential district cannot possibly obtain a really good load factor, even supposing that the district is saturated with every kind of domestic electrical apparatus ever devised. The inhabitants will always need much more electricity at Christmas than at midsummer, and their consumption between the hours of midnight and early morning will be almost negligible, however attractive the prices quoted. In view of these circumstances it is somewhat surprising that electricity undertakings generally have not sought to bring about the fuller use of their machinery by means independent of the requirements of their normal customers. In other words, they might become consumers themselves, adjusting their own demand to suit the machinery available at any time. The average cost price of the electricity they generated would thus be sensibly reduced with advantage to their normal business and favouring also the success of their auxiliary enterprise. What form this enterprise might take is a matter for consideration. Some electro-thermal or electro-chemical or refrigerating process is obviously indicated, for the primary object is the consumption of large quantities of power without involving any heavy capital expenditure or highly technical supervision. The more amenable the process may be to daily or seasonal variations in the supply of power available the better, but it should not be forgotten that an absolutely steady load from one year's end to another, added to the normal output of a station, will improve the load factor of the latter by making the peaks of less significance.

An important step in the direction we have indicated has been taken by Monsieur Leopold Herry in his station at Langerbrugge, a station already famous for the use of steam at the highest pressure in Europe and the highest temperature in the world, which was fully described in THE ENGINEER of June 4th, 1926. Mr. Herry chose the manufacture of calcium carbide as the process most suitable to his particular requirements, and now possesses, we believe, the only plant in existence in which calcium carbide is made by other than hydro-electric energy. His furnace, which has now been in operation nearly a year, provides a load of 3500 kW for the station and is capable of producing 20 tons of carbide per day, or about 5000 tons per annum. Previous to his enterprise Belgium produced no carbide and imported on the average 10,000 tons per annum. The raw materials, coke and lime, are, of course, readily available, and by employing them in the manner mentioned Mr. Herry has not only improved the load factor of his station, but has developed a profitable and economically sound business, which has made Belgium half independent of a foreign product necessary to her industries. If this sort of thing can be done in a comparatively small station like that at Langerbrugge, of which the rated capacity of the machines installed is only about 28,000 kW, there is evidently both greater need and greater scope in larger stations. All of them cannot certainly devote their surplus power of production to the manufacture of calcium carbide, large and increasing as is the demand for this substance. There are, however, plenty of other processes which might possibly be adopted to equalise the load factor of power stations. Nitric acid can be made from the air for the expenditure of about 8 kWh per pound, phosphorus from bone ash for about 10 kWh per pound, aluminium from alumina and cryolite for 14 or 15 kWh per pound, and so on. The preparation of magnesium, sodium, caustic soda, chlorine, hydrogen and oxygen can all be effected by electric or electrolytic methods. The list might be extended, or if auxiliary processes of a purely mechanical nature are preferred there is a fair number of possibilities to choose from. These in general would include the grinding or pulverising of materials, operations absorbing a considerable amount of power and capable of being stopped at such times as the power was not available.

Whether any given power station could add some manufacturing process to its normal activities with the success obtained by Mr. Herry, is a question which can only be answered with reference to the particular circumstances of the case. The idea is, however, an attractive one. The net cost of the electricity used would be extremely low, much lower, in fact, than it could profitably be sold to an independent manufacturer, as it would be burdened with no transmission costs. The increased load afforded to the power station would result in an appreciable reduction in the coal consumption per kWh. The extent of the reduction which would be obtained can easily be estimated. Taking the records of a certain station which we happen to have at hand, the electrical output for a recent month was 3,554,200 kWh, with a peak load of 12,450 kW. The load factor for the month was 38·3 per cent. If the load factor were raised to 80 per cent. by some auxiliary manufacturing process, the output would be increased to 7,410,240 kWh for the same maximum load. Since the coal consumption of the station per eight-hour shift was given by the equation $C = 15{,}400 + 1{\cdot}84\ k$.

where k is the number of kWh generated during any shift, it follows that the extra 3,856,040 kWh produced for the needs of the auxiliary process could be generated for an extra expenditure of only 1·84 lb. of coal per kWh. The coal consumption for the actual output was 7,971,900 lb., as can be deduced from the equation above, remembering that the month contained 93 shifts. Under the conditions of operation, therefore, the coal consumption per kWh was 2·24 lb., whereas with the additional load it follows from the equation that the total consumption for the month would have been 15,067,040 lb., or 2·03 lb. per kWh for the whole station, an improvement of nearly 10 per cent. This, however, is not all by any means. The capital charges, in the case assumed, would be spread over more than double the number of units generated, and thus would be approximately halved per unit. Labour and maintenance costs would also be greatly diminished per unit generated even if not quite in the same proportion. The net result would be a substantial reduction in the price at which electricity could be produced. How the saving would be allocated would be a matter of policy. If the cost of running the station was not increased by more than the cost of the additional fuel burnt, power could be furnished to the auxiliary industry, in the case we have taken for an illustration, at a price per kWh not greater than the cost of 1·84 lb. of coal. At such a price electro-chemical industries could be operated in conjunction with power stations at least as favourably as in conjunction with the average hydro-electric plant. Even if this figure were doubled to allow for extra labour and maintenance costs due to the extra load, the price would still be an exceedingly attractive one for many purposes. There would appear to be plenty of room to charge the auxiliary industry with a price at which it could prosper and still leave a substantial margin for the benefit of the ordinary customers of the station. The question is well worth looking into, and Mr. Herry's lead should inspire confidence in those thinking of following his example.

Street Noises.

Of the five senses of man that of hearing is the most neglected. Feeling and taste are, for obvious reasons, left to the individual, but public authorities see to it that his nose is not offended, and they do something to preserve his eyes from unseemly sights, and to provide them with adequate illumination. But to his ears they pay little or no attention. They have indeed prohibited whistling for cabs, and in certain streets the calling of wares, which was at one time one of the distractions of great cities, is no longer permitted; but they still tolerate the noise of traffic and the penetrating percussions of the atmosphere with which the ubiquitous road-breaker and the maker of steel buildings shatter our auditory nerves. If we turn from public authorities to private employers of labour, we find a similar indifference to the sense of hearing. Careful attention is paid to lighting, and even smelling is protected in some measure by removal of offensive fumes, but the noise of machinery, of hammers and the thousand and one appliances that the engineer has invented, is allowed, unchecked, to threaten the very existence of the ear drums. So profound is the indifference to the ill-used sense of hearing that when we have commented upon the intolerable noise in a boiler shop we have been told that it was a "pleasant busy sound."

This remarkable exclusion of one sense from the consideration which is shown to others can only spring from the belief that noise is not injurious. Happily, an opposite view is beginning at length to gain ground. The effect of continual irritation of the auditory nerves upon the nervous system as a whole is now receiving the attention of experts. It is surprising that it should have been overlooked so long, for everyone of us is conscious of the distraction of noise, of the excessive concentration on listening that it involves, and the undue strain upon the organs of speech that it causes. In many a London office it is now impossible to talk easily with the casement open, and in some the employment of double windows is the only means of securing reasonable peace. In New York the offence is yet greater. The noises of the thoroughfares combine with the internal noises of the "block," and penetrate to the highest floors of the highest buildings. The defence there, as here, is that "what can't be cured must be endured." Noise is tolerated because it is regarded as inevitable, and is even permitted to be carried to extremes for the same reason. To remove this deplorable offence two lines of action must be taken. First, it must be proved that noise is more than an inconvenience and is really injurious, and, in the second, it must be shown that it can be reduced. With both these objects in view there has been estabished a Movement for the Reduction, or Prevention of Harmful Noise. It has a hard row to hoe, but it is making, already, some progress, and is by degrees attracting the attention of the public. It is a significant fact that its most active member is Professor Spooner, a veteran engineer, who presented in the spring of this year at a meeting of the International Fatigue Committee of the American Society of Industrial Engineers a very remarkable indictment of noise, which may be found on page 18 of our issue of July 1st. We say this fact is significant because there can be no doubt at all that, with the exception of certain modern musicians, the engineer is responsible for the majority of the noises of the home and the street, and all the noises of the workshop, and that it is to him that the public must look for its removal. In the streets the traffic is the principal offender. There the problem of reduction must be attacked from two standpoints. First, that of the internal noises of self-propelling vehicles, and, secondly, that of the noises which result from the impact and friction of the wheels upon the road. As far as the latter is concerned, the adoption and preservation of smooth road surfaces has already done much, and may yet do more. The rubber-faced road which is now being tried may prove in part effective, but the maintenance of a true surface, as, for example, by grinding or milling, would perchance be even more effective. The employment of rubber tires, preferably inflated, has effected an enormous reduction of noise. Indeed, as far as wheel and road are concerned there is not great cause for complaint. But the vehicles themselves are intolerable. It is only necessary to concentrate the attention for a few moments on street traffic to be convinced that it is the internal noises of vehicles, and particularly of the engine and gear, which are responsible for most of the disturbance, though the general lumbering of heavy reverberating vehicles like motor omnibuses, is, on certain thoroughfares, a close second, if it does not take the prior place. Of tramcars we say nothing; they are beyond words. Now, as far as the internal noises are concerned, they are, unquestionably, reducible. Every noise made by machinery in motion is an indication of a defect. It implies friction or knocking, or the useless beating of the air. It is something of which the engineer should be ashamed. The noise of vehicles is produced, partly by the rattling and rubbing of parts which are too flexible or are not properly secured, and partly by the mechanism itself. The fact that many cars deserve the epithet silent is sufficient evidence that these causes can be removed. The use of accurately cut or ground gearing in a properly designed and constructed case will reduce that element of noise to zero. But it is not sufficient that the car should be silent when it leaves the maker's shop. It should be so constructed that with reasonable handling it will remain silent over a long period. Generally speaking, it is the mishandled or elderly vehicle that offends most. It is now possible for the police to prohibit the use of the open exhaust; it ought to be equally possible for them to prohibit the use of exceptionally noisy vehicles.

It is to be hoped that phonographic records of street noises are being secured and buried under the foundation stones of monoliths and public buildings or preserved in heat-proof safes from which they may be redeemed by those of our ancestors who desire to know the conditions of city life in the twentieth century. The noise of our streets is, past all challenge, one of the outstanding characteristics of present-day existence, and no one in the remote future will be able to understand the deplorable condition in that respect in which we live if such records are not preserved. For in those days noise will be classed with dirt and darkness, and as now we recall with disgust the filth of Tudor streets, so then will they marvel that an age which pretended to be advanced could tolerate a ceaseless cacophony which threatened the nervous system of human beings, weakened their powers of application, and sent them home weary and irritable when the day's work was done.

The forthcoming retirement is intimated of Mr. H. D. Smith, the Plymouth divisional engineer, Great Western Railway, who will be succeeded by Mr. H. S. B. Whitley. The latter will be followed, as Gloucester divisional engineer, by Mr. F. J. Tyley, assistant divisional engineer, Taunton.

The Engineering Industries of Canada.

No. II (*Conclusion*).*

It will bear repeating that, taking the long view, the arguments in favour of establishing any industry, and particularly an engineering industry, in Canada, arise out of the fact that the population of this immense territory is growing at a rate four times as fast as that of the world as a whole. In sixty years, starting from 1867, the number of inhabitants has increased by three times. It will easily duplicate this feat in the next sixty years and probably in the next fifty years. Since 1900 the rate of increase has been accelerated; the first decade showing a 34 per cent. increase and the second decade—in spite of the war—a 22 per cent. increase. A 35 per cent. increase every decade through the rest of the century is not outside the bounds of probability; but even if the rate of increase is only 20 per cent., there will be a population of fifteen million people in the Dominion by 1950. But, taking into consideration immediate factors, the establishment of an industry in Canada demands the most careful consideration; as to position of plant, whether it is better to be near sources of supplies or the best available market; as to labour costs, which are higher than in the British Isles, as a rule; as to the costs of selling and publicity if the product is a competitive one; as to the tariff on such foreign materials as may be needed and on the finished product.

In the first article a great deal of attention was given to the development of the hydro-electric industry, not only because of its inherent importance, but because it is a key industry which is a better indicator of the development of manufacturing and of the primary industries in Canada than almost any other. The total wealth of Canada exceeds £4,400,000,000, and about £1,600,000,000 of that represents agricultural wealth. The distribution of wealth among the industries of Canada can be gathered from the following table:—

Table III.

Industries.	No. of Employees.	Capital. £	Value of Products. £
Pulp and paper	23,031	92,100,000	38,618,587
Flour and grist-mill	6,166	12,020,852	37,588,946
Slaughtering and meat	10,709	11,000,000	33,000,000
Saw-mills	35,458	41,000,000	27,000,000
Butter and cheese	10,548	7,458,000	25,000,000
Automobiles	10,301	15,000,000	22,167,000
Electric light and power	13,263	145,344,216	20,517,576
Rubber goods inc. footw.	12,962	12,112,000	15,645,915
Cotton yarn and cloth	20,497	16,722,000	14,556,000
Sugar refineries	2,784	10,000,000	13,689,000
Castings and forgings	17,120	17,000,000	12,351,000
Bread and bakery prod.	12,438	6,760,000	12,070,000
Elec. apparatus and supp.	14,112	15,075,000	12,032,000
Non-ferrous metal smelt.	5,104	12,338,000	11,237,000
Printing and publishing	14,187	9,680,000	11,000,000
Railway rolling stock	20,202	15,600,000	11,000,000
Petroleum	3,738	10,116,000	10,153,000
Hosiery, knit goods & gloves	14,698	10,000,000	9,712,000
Clothing, women's fact.	13,490	4,341,000	9,352,000
Biscuits, confectionery chewing gum	11,958	8,154,000	9,349,000
Cigars and cigarettes	5,846	6,113,000	8,398,000
Boots and shoes, leather	13,791	6,173,000	8,005,000
Planing mills, sash and door factories	10,105	9,750,000	8,002,000
Breweries	4,073	10,224,500	7,780,000
Clothing, men's factory	10,818	4,840,000	7,650,000

Of Canada's land area about 1,227,000 square miles are covered with forests. About two-fifths of this forested area carries merchantable timber (6in. in diameter) and only one-fifth carries saw timber (10in. in diameter), the rest being occupied by young "stands" which have come up after fire or cutting. It is estimated that this area contains 482,075,000,000 feet-board measure of saw material and 1,279,705,000 cords of pulpwood, cordwood, poles, &c. Five thousand million cu. ft. a year are destroyed by fire or insects, and as the total primary forest production involves the cutting of more than 2,500,000,000 cubic feet of standing timber annually, it can be seen that the annual average increase of ten cubic feet per acre, if it can be maintained, makes up for this depletion. Primitive operations, which once were possible in Canada, have been abandoned, as the most accessible forests have been exhausted; and a large demand on engineering talent is now made to overtake the increased costs of longer haulage. Logging railways from the woods to the mill, and tractors instead of horses, are developments which may be expected to increase in many cases. Pulp and paper mills no longer make wood-cutting a seasonal operation. In British Columbia the scarcity of drivable streams and the size of the logs has led to a wide use of donkey engines to haul and assemble the logs by means of a cable system. Canada's saw-mills produce about 3,900,000,000ft. board-measure of sawn lumber, most of it coniferous soft wood, and large quantities of shingles, lath, prepared pulpwood, sleepers, box shooks, veneer, pickets, staves, hoops, and heading and spoolwood. The tendency of the industry is towards consolidation of companies in the matter of timber holdings, and toward the building of fewer and smaller, but more efficient, saw mills situated nearer to the source of supply.

Pulp and Paper.

The pulp and paper industry has grown up almost

* No. I. appeared August 12th

entirely during this century, and now ranks first among Canadian manufacturing industries. In 1925 the mills produced 2,772,507 tons of pulp; of this 1,654,549 tons were used in combined pulp and paper mills for the manufacture of paper; 155,925 tons were sold to other paper mills in Canada; and 962,033 tons were exported. Half the pulp produced was groundwood, about one-quarter was unbleached sulphite, 8 per cent. was bleached sulphite, and the remainder was sulphate or kraft pulp and screenings. The paper produced in 1925 amounted to 1,884,705 tons, of which newsprint made up 1,536,523 tons. The remaining 19 per cent. was divided among paper boards (8 per cent.), wrapping paper (5 per cent.), book and writing paper (4 per cent.), and miscellaneous papers (2 per cent.). The production of paper increased by 120 per cent. in nine years, and in 1926 Canada turned out 200,000 tons more than the United States, previously the world's greatest producer. Her exports of "newsprint" are greater than those of the rest of the world combined:—1,731,986 tons, valued at £23,000,000. Less than 40 per cent. of the forest products exported were unmanufactured, and every year a smaller proportion of these products leave Canada as raw material. Some notable developments are the manufacture of artificial silk or rayon from Canadian spruce wood, the production of linoleum, dynamite, and gramophone records from a flour made of wood, the operation of sawmills having a capacity of more than half a million feet board measure in ten hours, and the production of newsprint from a single machine continuously at the rate of half an acre a minute.

Mining.

Mining is now Canada's third industry, and the possibilities are enormous. Though she produces 90 per cent. of the world's nickel, 85 per cent. of the world's asbestos, 55 per cent. of the world's cobalt, 9 per cent. of the world's gold, 8·7 per cent. of the world's lead, 8·4 per cent. of the world's silver, 6·4 per cent. of the world's zinc, and 4 per cent. of the world's copper, it is very likely that her production of all of these, and especially gold, silver, copper, lead and zinc, will increase. There are great mines approaching the production stage at the present moment, large mills are being built here and there in Ontario, Quebec, Manitoba and British Columbia, but the available area of exploitation is only touched. At one time that great area of Canada which is not agricultural was regarded as of no value, but now the Canadian Shield is continually on the lips of economic geologists. The Canadian Shield surrounds Hudson Bay on the east, south and west, with a U-shaped form, and has an area of approximately 1,800,000 square miles. It has a breadth of 2000 miles along Hudson Straits and the Arctic Ocean, but narrows until it enters the United States at a point both south and west of Lake Superior. It includes a great part of Northern Quebec, Northern Ontario, Northern Manitoba. The southern part of the Shield is a rich, forested region, and everywhere it is marked with innumerable ponds and lakes scattered over its surface. The Precambrian strata which underlie most of the Canadian Shield have received most attention in a broad district that stretches 400 or 500 miles northward and north-eastward from Lake Huron, and contains the gold mines of Porcupine and Kirkland Lake, the Cobalt silver field, the Sudbury nickel-copper deposits, the iron ores of Michipicoten, and other notable mineral deposits. The district where most of the productive mining is taking place is 700 miles long, but is but a small part of the Canadian Shield. Prospecting and mining as far west as Saskatchewan have produced many interesting prospects. It is expected by geologists that valuable mineral deposits will eventually be found widely distributed over much of the Shield. In 1926 the value of Canada's mineral production was approaching £50,000,000, made up as follows:—Coal, £12,000,000; gold, £7,228,380; lead, £3,853,000; copper, £3,476,000 (to increase greatly); nickel, £2,875,000; cement, £2,603,000; zinc, £2,400,000; clay products, £2,100,000; asbestos, £2,020,000; natural gas, £1,650,000; stone, £1,562,000; sand and gravel, £932,000; lime, £758,000; gypsum, £553,000; salt, £296,000; crude petroleum £261,000; and cobalt, £223,300. Canada is the sixth largest producer of aluminium and the great smelter at Arvida, Quebec, has yet to come into operation.

From the Hollinger gold mine at Timmins, Ontario, nearly 2,000,000 tons of ore were removed in 1926, while Dome and McIntyre nearby produced another million tons. Hollinger is increasing output steadily, and it is expected that it will become the world's largest producer. No one knows how deep these mines go, but it is expected that they will be rich at very great depths. The Sullivan mine in British Columbia is the world's largest lead and zinc mine, a million tons being produced in 1926. At Trail the Consolidated Mining and Smelting Company, Ltd., has the world's largest non-ferrous metallurgical works, treating more than half a million tons of ores and concentrates annually and producing in 1926 about 262,000,000 lb. of lead, 135,000,000 lb. of zinc, 21,000,000 lb. of copper, 7,000,000 fine ounces of silver, and upwards of 50,000 fine ounces of gold. In coal, Canada has one-sixth of the world's known reserves, but these are handicapped at present by being situated in comparatively thinly populated parts of the Dominion. As a result, Canada is a heavy importer of coal from the United States to supply the central provinces of Ontario and Quebec.

Transport.

With all these important developments, the construction industries have naturally a very vital part to play. Railway construction was a very important phase of Canada's life in the first fifteen years of this century, when it finished two trans-continental railways. That is done; and no more trans-continentals will be built. The people of Saskatchewan and part of Manitoba are insisting that the Federal Government shall build the Hudson's Bay Railway, despite the great expenditure which would be entailed. The whole project is being studied for about the fifth time now, as there is a great deal of dissension about the feasibility of the route for grain carrying. If executed, whether much grain is ever carried or not, the Dominion Government will have to make the route as safe as possible by buoys, lighthouses, ice breakers, and so on. Normally, there is a good deal of railway construction to do in any case. In 1925, for instance, new railway lines opened amounted to 506 miles, while in the same year 166 miles were completed, but not opened for traffic, with 559 miles more projected or under construction. The steam and electric railways normally spend from 34 to 37 million pounds a year on maintenance of way and structures. The Dominion Government has co-operated since the war with provinces, counties, townships and urban municipalities in heavy programmes of road construction. These Local Authorities have had additional programmes of their own in which they did not receive federal aid, and if one adds to the outlay involved on such works, the large annual expenditures on new telegraph and telephone lines, canals, harbours, central electric stations and waterworks, the total sum reaches a very high figure. As most Canadian householders in the cities and towns—and to a growing extent in the rural areas—have telephones, construction on this one item is almost as great as for the railways for new construction. The building industry in its entirety is estimated to involve the expenditure of half a billion dollars in a year of normal activity.

The total steam railway mileage in operation is 40,352, and the railways employ 166,027 persons, paying salaries and wages of £47,600,000 and making gross earnings of £91,000,000 per year. The railways use 30 per cent. of all the coal consumed in Canada. There are sixty-three electric railway companies in operation, owning more than 2500 miles of track, about 5000 cars, and having a capitalisation of about £44,444,000. They pay annually £5,000,000 in wages and have gross receipts of £10,000,000. There are 385,000 miles of highway in Canada, most of the good roads being of recent construction outside of the cities as a direct result of the development of the motor car. There are more than 800,000 motor cars registered in Canada and about one-fourth of that number is manufactured in Canada yearly. There is one motor car to every twelve persons in Canada, Ontario having the largest number, with one to every nine persons. Air navigation is becoming increasingly important as the means of transporting passengers and supplies to new and remote mining areas, for detecting forest fires in their incipient stages, for surveying and mapping new territories. The Provincial Governments have more or less undertaken this form of transportation and it is difficult for commercial companies to make way against them.

The vessels on the Canadian shipping registry in 1925 were 7913 in number, with a tonnage of 1,283,033. Shipbuilding is not an important industry in Canada at the moment. In the 'seventies the building of wooden sailing vessels was a flourishing industry, but the iron steamboat nearly killed it until the war again stimulated building of ships. There are some large shipyards at Collingwood and elsewhere on the Great Lakes for building lake vessels; there are large dry docks either erected by the Government or with Government aid in every seaport; and on the Pacific Coast there is a good deal of activity in repair work as well as in building. There is considerable building of small pleasure craft.

There are 284,000 miles of telegraph wire in Canada, handling fifteen million messages for a revenue of £2,200,000. In addition, six trans-oceanic cables have termini in the country, five on the Atlantic and one on the Pacific, and they handle six million cablegrams annually. The Marconi Wireless Telegraph Companies operates to Canada and in Canada, and some thirty-four Government-owned and seventy-four privately owned radio telegraph stations are on the sea coasts and the Great Lakes. There are 135,485 radio stations.

There are more than 1,200,000 telephones in Canada with three million miles of wire and a capital of £35,000,000 invested.

In 1925 Canada possessed 22,331 manufacturing establishments with a capital of £762,000,000 invested and employing 544,014 persons for wages and salaries of £120,000,000. They consumed £318,000,000 worth of raw material (not including fuel) and produced goods valued at £589,800,000.

Coal, Iron, and Steel.

The coal mines of Nova Scotia have been very profitable to the owners, though their value has been somewhat obscured of recent years because they have operated within the British Empire Steel Corporation, a vertical combine which has not proved successful in unifying the coal and steel industries of that province. A great deal of research work is going on now to seek out the best conditions for combustion of the different grades and with the object of spreading further through Canada the area of their consumption. Alberta coal miners are also struggling to overcome the handicap placed on them by distance from the great Ontario market, and are gradually crowding out American coals from the West. Coke is now widely manufactured, though with a value of its products at £2,500,000 it is only at the beginning of its possibilities for utilisation. The development of central heating—and there are reasons to expect an accelerating tendency towards that way of dealing with the fuel problem—should lead to greater demands for coke and lower-grade fuels than anthracite.

The following statistics of development in the making of iron and steel and their products in Canada are of value:—

	Plants.	Capital. £	Persons employed.	Sales. £
Pig iron, ferro alloys, steel and rolled products:				
1922	25	15,700,000	5,896	7,100,000
1926	26	17,314,000	6,014	8,252,000
Castings and forgings:				
1922	329	16,175,000	16,484	11,000,000
1926	331	17,832,000	18,518	13,642,000
Boilers, tanks and engines:				
1922	43	2,074,100	1,616	981,000
1926	34	1,771,000	1,513	1,064,200
Agricultural implements:				
1922	73	18,513,400	6,221	3,650,000
1926	68	15,120,000	9,107	6,382,000
Machinery:				
1922	135	10,086,000	7,368	4,500,000
1926	156	11,987,100	9,568	7,674,000
Automobiles:				
1922	15	9,552,000	7,384	16,392,000
1926	11	16,588,400	11,905	26,720,000
Auto. parts and accessories:				
1922	62	3,309,130	3,173	3,802,000
1926	78	2,102,100	2,765	2,784,000
Bicycles:				
1922	5	215,400	392	192,000
1926	5	513,000	482	291,000
Railway rolling stock:				
1922	28	11,000,000	10,045	5,660,000
1926	35	16,403,000	22,265	14,500,000
Wire and wire goods:				
1922	48	3,465,600	3,128	3,123,100
1926	60	3,720,000	3,094	3,331,200
Sheet metal products:				
1922	125	6,123,000	6,434	6,042,000
1926	135	6,540,000	7,365	7,840,000
Hardware and tools:				
1922	111	7,350,000	5,331	2,996,000
1926	120	6,368,000	6,151	4,530,000
Iron and steel products:				
1922	47	1,692,000	1,872	1,426,000
1926	69	2,181,320	2,667	2,276,000
Total for Canada:				
1922—1046 plants with a total capital invested of £105,255,000 and employing 75,344 workers for salaries and wages of £18,330,000 and selling at £66,864,000 and adding by manufacturing a value of £33,000,000.				
1926—1126 plants with a total capital of £118,440,000 and employing 101,414 persons for £27,000,000 and selling products at £99,286,000, adding by manufacturing a value of £48,400,000.				

BOOKS RECEIVED.

Income Tax and Super Tax in the Irish Free State. Compiled by C. H. Tolley. London: Chas. H. Tolley, 4, Great Winchester-street, E.C. 2.

Data for Engineering Inquiries. By J. C. Connan. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 12s. 6d. net.

Running, Maintenance and Repair of Diesel Engines. By P. H. Smith. London: Constable and Co., Ltd., 10-12, Orange-street, W.C. 2. Price 3s. 6d. net.

Hydraulics. By E. W. Schoder and F. M. Dawson. London: McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 17s. 6d. net.

Report of the Food Investigation Board for the Years 1925-1926. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 2s. 6d. net.

The Elements of Telephone Transmission. By H. H. Harrison. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 5s. net.

The Fatigue of Metals. By H. F. Moore and J. B. Kommers. London: McGraw-Hill Publishing Company, Ltd., 6, Bouverie-street, E.C. 4. Price 20s. net.

Diesel Engines for Land and Marine Work. Sixth edition. By A. P. Chalkley. London: Constable and Co., Ltd., 10-12, Orange-street, W.C. 2. Price 24s. net.

The Spinning of Aeroplanes. By S. B. Gates and L. W. Bryant. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 6s. 6d. net.

Flame and Combustion in Gases. By William A. Bone and Donald T. A. Townend. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 32s. net.

Tolley's Complete Income Tax, Super Tax, Corporation Profits Tax, Excess Profits Duty, &c. London: Chas. H. Tolley, 4, Great Winchester-street, E.C. 2. Price 3s. post free.

Report on Tabulating the Results of Heat Engine Trials, with Appendices: Presented to the Council of the Institution of Civil Engineers by the Heat Engine Trials Committee, 1927. London: Wm. Clowes and Sons, Ltd., 94, Jermyn-street, S.W. 1. Price 5s.

Steam Tractor for Overseas.

THE steam tractor which forms the subject of the following description has been especially designed by the Sentinel Waggon Works, Ltd., of Shrewsbury, for work overseas, and is suitable for all general purposes which require a powerful machine. Its engine develops 86 B.H.P., it weighs without fuel and water 9 tons, and without spuds can exert a draw-bar pull of over 6700 lb., and with spuds on firm ground it has, to use a locomotive term, a starting tractive effort of 10 tons. The design is interesting because the tractor can overrun hedges and 3ft. banks, while every part is both immediately accessible, and at the same time protected against grit; the semi-exposed rear chains form the only exception.

Frame and Wheels.—The frame is a box girder, built up of flanged steel plates running the full length of the machine, and connected by steel foot plates, cross members and water tanks. The engine lies horizontally at the front, unencumbered by other gear, and between it and the rear axle is placed a vertical boiler with a bunker capable of easy extension behind it.

The front wheels—Fig. 1—are 4ft. diameter by 7in. wide, and are fitted with a standard Ackermann steering gear employing an enclosed worm and nut in an oil bath. The axle is sprung by a six-leaf transverse laminated spring, 3in. wide by 2ft. 6in. span, having a central one-point connection to the tractor frame. By the use of a pivoting triangular bracket, the axle may tilt to permit of full road wheel grip on uneven ground. A sliding die between two rubbing plates is provided to take up wear in the arrangement. The rear wheels are 6ft. 6in. diameter by 1ft. 6in. tread, and are of built-up mild steel construction having spokes electrically welded to steel bosses. By the use of extension rims the wheel width may be extended to 24in. The pressure on the ground with 18in. rims and with 1in. of sinkage is only 25 lb. per square inch. For draw-bar pulls of over 6720 lb. spuds of a wedge shape are available. The rear axle is of nickel steel, and carries two laminated six-leaf semi-elliptic springs, 3in. wide by 2ft. 2in. span, giving with the front spring a three-point suspension, and is of the dead type. The wheel journals are 14¾in. wide by 4¾in. diameter. From the drawing, Fig. 2, of one half of the rear axle, it will be seen that close to the near side wheel there is mounted a winding drum, 30in. diameter by 3¾in. wide. To this drum, which takes 130 yards of ¾in. wire rope of 170 yards of ¾in. rope, the sprocket wheel is bolted. It can be uncoupled from the driving wheel by removing two pairs in the usual way. The maximum pull the drum can exert is about 13,500 lb.

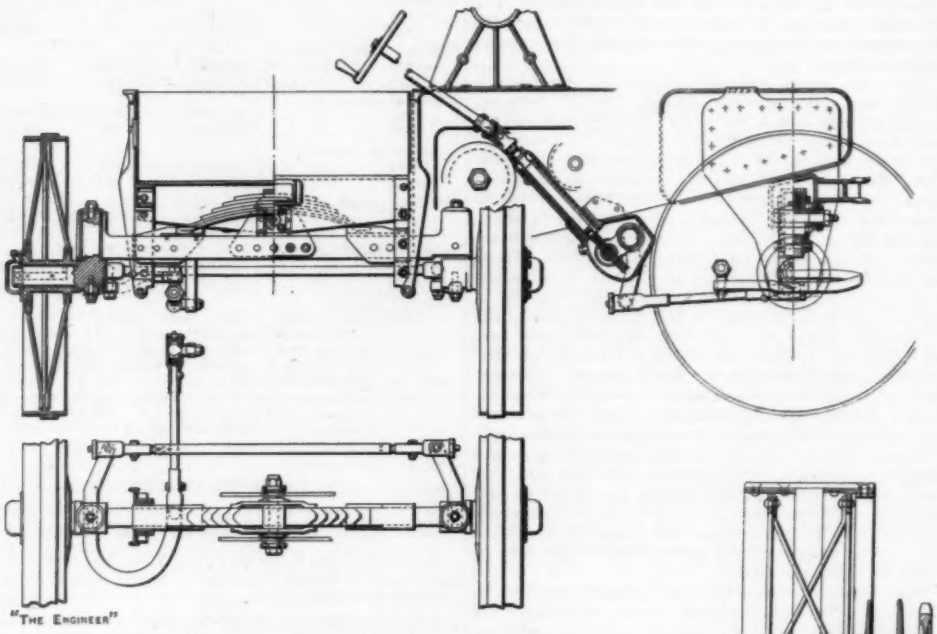


FIG. 1—FRONT WHEELS AND AXLE

Two draw-bars are provided, a low one for ploughing and one at the normal height for road haulage. A central draw-bar bracket at the front is useful for shunting.

The leading dimensions of the tractor are:—Overall width, 8ft. 4in.; overall length, 15ft. 9in.; wheel-base, 9ft. 9in.; track, 6ft. 10in.; minimum clearance, under the rear water tank, 18in.; turning circle, 25ft. 6in. The weight without fuel and water is, as already said, 9 tons.

The Engine.—The engine is rated at 86 B.H.P., but can develop well over 100 B.H.P. for short periods. It has two double-acting high-pressure cylinders, 6¾in. bore by 9in. stroke. The steam and the exhaust valves are of the poppett type, placed on opposite sides of the cylinders. They are operated by push rods from two cam shafts running in the crank chamber, and are provided with easily adjustable tappets. Variations in the cut-off are obtained by sliding the cam shafts. The standard points of cut-off are 75 per cent. for starting, and 30 per cent. for ordinary running. Cams are provided for forward and reverse running at these cut-offs. There is also a central position when all valves are opened.

The crank chamber is oil-tight and the piston-rods pass through double glands to prevent any water from the cylinders entering the crank case and affecting the oil. The connecting-rods, crank and crank shafts, timing gears and water pump are all automatically lubricated and the cylinders are lubricated by a positively driven engine oil pump.

The Two-speed Gear Box.—The drive is given by a 2½in. pitch enclosed chain to a cast steel two-speed gear-box—

STEAM TRACTOR

THE SENTINEL WAGGON WORKS, LTD., SHREWSBURY, ENGINEERS

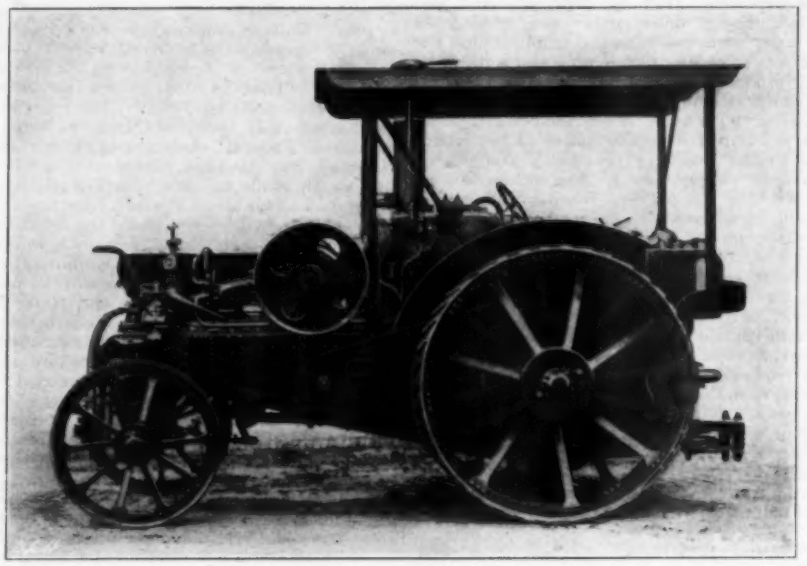


Fig. 4—fitted with nickel chrome spur gearing, which gives engine-to-road-wheel ratios of 13·17 to 1 and 30·6 to 1 respectively. The primary shaft, which has roller bearing, has pinions of forty-seven and nineteen teeth respectively, and has a thrust bearing on the near side. The secondary shaft carries a bevel type four-pinion differential gear with two toothed rings, having eighty-five and eighty teeth respectively. It has thrust bearings at each end. Both these shafts are of nickel steel. The thrust bearings are of a single type designed for double application, and the makers point out that the ball races therefore must be a few thousandths free in their housings, radially between flanges and also in the bore.

The striking gear is simple, the gears being engaged by sliding either the primary or the secondary shaft. To prevent both gears being engaged at once, a floating peg arrangement is used—see detail, Fig. 4, page 209.

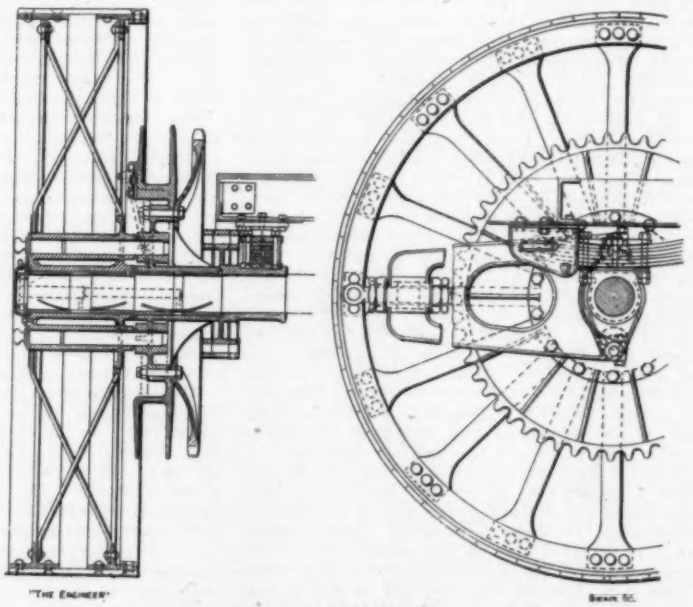


FIG. 2—DRIVING WHEEL AND WINDING DRUM

At 250 r.p.m. when the engine develops 88·6 B.H.P., the road speed on low gear is 1·87 m.p.h.—*i.e.*, ploughing speed—and on high gear 4·42 m.p.h. The engine is governed at this speed by a Pickering governor. For higher speeds, the governor belt may be slipped off, when the engine will attain speeds up to 600 r.p.m., though speeds above 500 r.p.m. have not the maker's approval. By interchanging the engine chain pinion with the gear-box pinion, a speed of 10 m.p.h. on top at 250 r.p.m. may be obtained.

Through the differential the drive is taken by two 2½in. pitch roller chains, each containing eighty-six pitches—18ft.—to two fifty-two teeth sprockets, one bolted on the haulage drum, and one on the offside back wheel. The chain pinions on the gear-box countershaft have eleven teeth. Threaded radius rods provide means for chain adjustment. A plan recommended by the makers is to keep two chains in use and two in a graphite bath, thus permitting a change-over at convenient intervals to be effected.

The Boiler.—A vertical boiler supplies steam at 275 lb. pressure superheated to 600 deg. Fah. It has 66 square feet of heating surface and a maximum evaporation on Welsh steam coal of 2400 lb. per hour. The steam consumption is given as 20 lb. per B.H.P. hour. To facilitate scaling, the fire-box may be dropped away from the outer shell by breaking joints at the top and bottom. The construction is such that no stays are used, the fire-box or inner shell containing expanded tubes arranged in staggered rows. Water circulates both through the tubes and between the two shells. In the space above the tubes a superheater is arranged. Fuel is fed through an opening at the boiler top, the arrangement of the tubes guiding the combustible pieces. The hydraulic test pressure for the boiler is 450 lb.

Performance.—The makers inform us that the draw-bar pull on firm land with spuds on the wheels is over 10 tons at starting. The ploughing draw-bar pull is 4 tons at 2 m.p.h. At 6 m.p.h. the draw-bar pull is 1½ tons. For short periods the pull may be 6 tons at 1½ m.p.h. The capacity of the tractor is from six to fifteen ploughs, a 14in. wide Colonial Monel plough requiring a pull of 350 lb. to 1600 lb. at 6in. deep working, according to the soil. The output of such a plough during ten hours is roughly 2 acres.

The tractor can haul a load of 20 tons where the ground is good though hilly, but when wet surfaces limit the road grip, this figure must be cut in half. The tractive effort required per ton on broad steel shod wheels is about 60 lb. on an earth road in a dry state with no gradient.

It has been found that the 10 cwt. of coal which can normally be carried is sufficient for 30–35 miles, and 280

THE SUPER-SENTINEL RHINOCEROS STEAM TRACTOR

THE SENTINEL WAGGON WORKS, LTD., SHREWSBURY, ENGINEERS

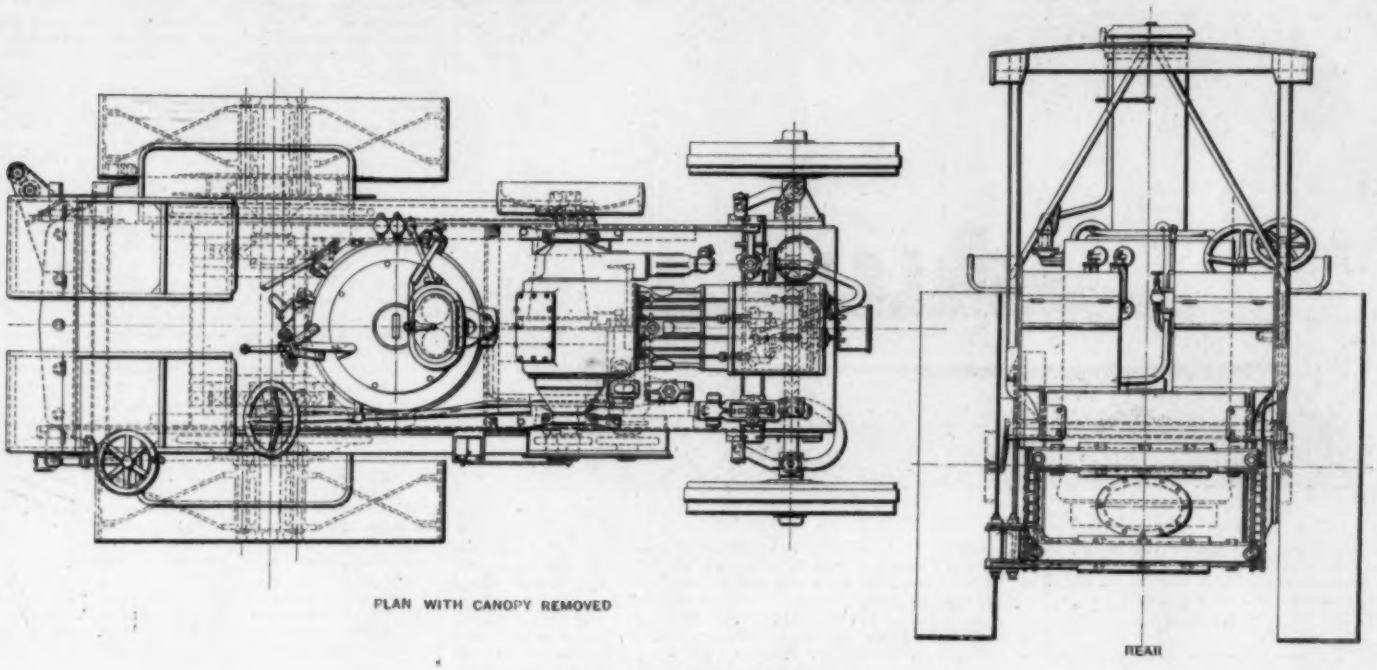


FIG. 3—PLAN AND REAR VIEW

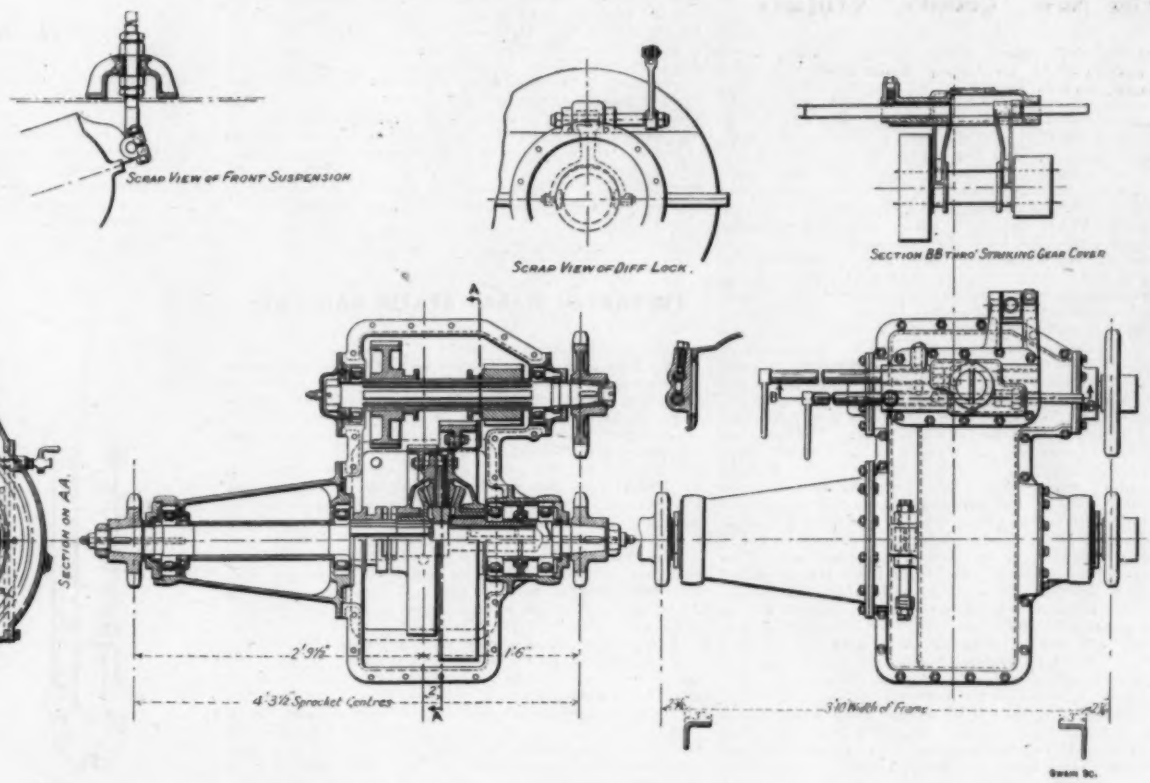


FIG. 4—GEAR-BOX, DIFFERENTIAL AND DETAILS

gallons of water for 15–18 miles. It takes seven minutes to refill the feed tanks. The boiler is fed by a Weir pump and by an independent pump working from the engine countershaft through reducing gear.

Fuels.—When used overseas, olive, wattle and gum woods, which are so plentiful in Kenya, may be burnt, along with many hardwoods. The woods must be dried and cut to about 10in. to 14in. long, and 3in. to 6in. square. When using such fuel, the output is about 60 B.H.P. The boiler will also give sufficient steam for heavy duty work on maize cobs.

For the protection of the driver a high canopy permitting a large air space between the footplate and the roof, is fitted. Two pressed steel sprung seats are also provided.

The New Station at Edgware-road.

THOSE who had to travel by the Metropolitan District Railway from Wimbledon, Putney Bridge and Earl's Court to Paddington, Baker-street, King's Cross, and other stations going east on the Inner Circle, were, until recently, forced to change trains at Kensington, High-street, Station. Even the regular passenger was often puzzled thereby, and the stranger was left in absolute confusion. That trouble is now a thing of the past, for the trains pass on to the Metropolitan metals at High-street, and run through to Edgware-road, and *vice versâ*. This improvement has been made possible by the reconstruction and enlargement of Edgware-road Station. Many of our readers may have their interest in that station revived, if we remind them that the locomotive running shed and repair shops of the Metropolitan Railway were there. They were situated in the space of ground between the down line and the Marylebone-road. That space was very limited, and the resources available were greatly taxed as the number of locomotives grew. When the new locomotive shops at Neasden were opened in 1880, on the St. John's Wood Extension reaching that point, the space was set free.

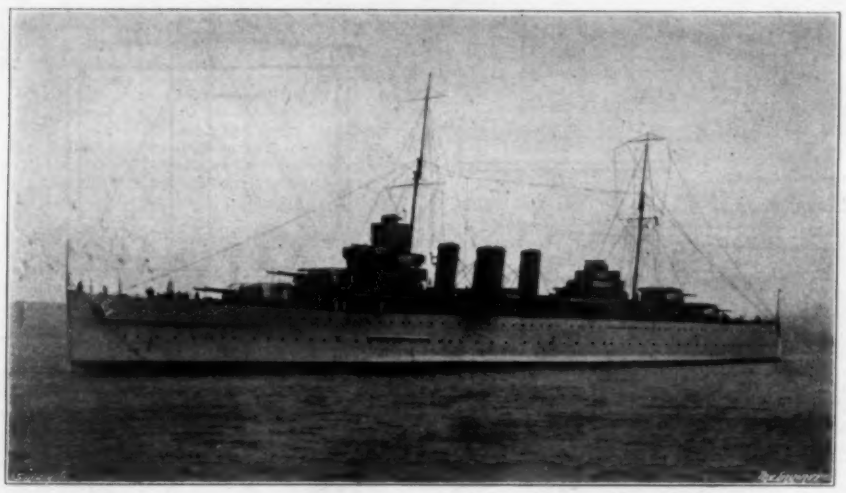
Edgware-road Station has always had an importance in that it is the first station on the City side of the junction between the Inner Circle and Hammersmith and City lines. Over the latter run not only the Hammersmith, but the Addison-road trains. A great improvement was made in 1910 by the conversion of a down siding into part of the down line and the portion of the latter—thrown out of use as a running line—being made into a siding between the main lines. This siding was given facing points in the up and trailing points in the down line, and was used as a terminal for the Addison-road trains, which, after being emptied on arrival at Edgware-road, ran into the siding by means of the facing points. The trainmen then changed ends and, when ready for departure, the trains left the siding by the trailing points for the down platform.

Until the changes now being completed, the station lay between two minor streets—Lisson-street and Lindestreet—off the Marylebone-road, but all the new station is to the east of Lisson-street and bounded on the south and east by Marylebone-road. It occupies in part the space formerly filled by the old locomotive shed and shops. There are two island platforms, 423ft. long, between the tops of the ramps. The main lines are on the outer side and two new loop lines on the inner. The latter lines are used by the Putney Bridge and the Addison-road trains. Direct access is given from the up main line into any one of three roads; trains can depart west from any one of three roads, and, in the rare event of it being necessary, can also go east from any one of three roads.

The station has been re-signalled, and is now operated by all-electric power. The plans and specifications for the work were prepared by Major R. Falshaw Morkill, the signal and telegraph superintendent of the Metropolitan Railway, and the work was executed by the Westinghouse Brake and Saxby Signal Company, 82, York-road, King's Cross, N. 1. One result of the power operation of the signalling at Edgware-road is that the junction between that point and Praed-street Station, at which the Hammersmith and City Railway branches off, is connected to the new signal-box, and the box in the tunnel near the junction has been dispensed with. The junction is about 307 yards from the signal-box, and thus is an illustration of the benefit of power, as compared with manual, operation; whilst it is also noteworthy as being only possible by the use of track circuit and an illuminated diagram, seeing that the signalman is unable to see the points or the lines in their vicinity. Owing to the signal-box being close to

H.M. CRUISER BERWICK

THE FAIRFIELD SHIPBUILDING AND ENGINEERING CO., LTD., GOVAN, BUILDERS



the northern pier of Lisson-street bridge, the signalman has no view of the lines on his west side, but that is also of little consequence, as their state is indicated on the illuminated diagram, and a track circuit holds the signals and points when the lines are occupied.

The New "County" Cruisers.

THE first five cruisers of the "County" class, which were authorised by the Labour Administration in 1924 and begun towards the end of that calendar year, are now approaching completion. In our present issue we are able to illustrate one of the ships of this group, H.M.S. Berwick, which has been built and engined by the Fairfield Shipbuilding Company, of Govan. Laid down in November, 1924, and launched on March 30th, 1926, this vessel arrived at Devonport on June 30th last to be commissioned for trials. After these have been completed she is to proceed to the China station, to which command the other four ships of the class have also been assigned.

There are many points of interest about this type, in regard to which fairly complete details are now available. So far as tonnage and armament are concerned, the design was governed by the Washington Treaty, which restricts the displacement to 10,000 tons—exclusive of fuel and reserve feed water—and the calibre of the heaviest guns to 8in. Within these limits the late Director of Naval Construction, Sir E. T. d'Eyncourt, who prepared the design, has, as we think, produced a very successful and efficient type of ocean cruiser, and one that fulfils the special requirements of British naval policy. The following dimensions of the class are taken from the current Navy Estimates :—Length, 590ft.; breadth, 68ft. 4in.; draught (at standard displacement), 16ft. 3in.; standard displacement, 10,000 tons. The hull differs from that of previous British cruisers in being flush-decked, and the freeboard is conspicuously lofty. These features should ensure a high degree of seaworthiness, in contrast to the majority of our present cruisers, which suffer from their low freeboard and are notoriously wet and uncomfortable in a seaway. Bulges are fitted as a protection against torpedo attack. Other protective details are still conjectural, but it is reported that a 4in. vaulted deck is worked over vital parts, and there is obviously some armour on the gun positions, though it cannot be of great thickness.

The ship is propelled by four sets of geared turbines, each developing 20,000 S.H.P., so that under a full head of steam the collective output is 80,000 S.H.P., operating four screws. The designed speed is 31¼ knots in smooth water with a clean bottom. This is at least 1¼ knots below the speed of contemporary foreign cruisers, but there were doubtless good reasons for accepting a comparatively moderate velocity. It may be that when the ships are at sea under service conditions they will prove little, if at all, inferior in speed to any other cruisers afloat. The uptakes from the oil-burning boilers are led into three funnels of unequal girth, but in spite of this the profile of the ship is symmetrical and pleasing. An exceptionally wide radius of action is guaranteed by the oil fuel supply of 3400 tons, which exceeds that of the "Raleigh" class, hitherto our largest cruisers, by 1250 tons. It is clear that the displacement of the ship, with bunkers and water tanks filled to capacity, will be over 13,500 tons.

The main armament is extremely formidable, comprising, as it does, eight 8in. guns, paired in turrets on the centre line, two forward and two aft. Guns of this calibre are new to the British Navy, forty years having passed since an 8in. weapon was mounted in British warships, *i.e.*, the four protected cruisers of the "River" class. It is of interest to note that the armament of the Berwick is practically similar to that of the German cruisers Scharnhorst and Gneisenau, which were sunk in the Falklands action. Each carried eight 8·2in. guns, four being mounted in twin turrets and four in single casemates on the broadside. Only six guns, therefore, could be fought on the beam, whereas the Berwick can train her eight guns on either broadside. The ballistics of the new 8in. guns are confidential, but it is certainly of a high-velocity model. Guns of this calibre listed in the ordnance tables of British manufacturers discharge a projectile weighing 250 lb., that is, 50 lb. heavier than the 7·5in. mark and 150 lb. more than the 6in. A full broadside from the Berwick should thus weigh 2000 lb. As will be seen from the illustration, the twin gun-houses are very roomy, the two guns are widely separated, the ports appear to be cut for a high angle of elevation, and a large-base range-finder is fitted to every gun-house. Particulars of the secondary armament and the torpedo installation have yet to be released.

It will further be observed that the bridge work is of a very elaborate nature. In it are housed the gun control tower, the director towers, spotting platforms, and all the gear necessary for fire control, besides the usual navigating and signalling stations. This imposing bridge structure has the obvious disadvantage of offering a large area of target to shell fire. The heavy tripod which has long been a familiar feature in our cruisers has disappeared, its place being taken by a slender pole mast carrying light signal yards. The main mast is a pole of the same height. The completion of the Berwick and her four sisters brings a much-needed reinforcement to our cruising fleet. Including the two Australian ships, there are now thirteen cruisers of the 10,000-ton class under construction in this country, and a further unit is to be ordered during the current financial year. The cost of the Berwick is returned in the Navy Estimates as £1,853,000, including guns.

FEDERATED MALAY STATES RAILWAYS.

THE annual report of the chief secretary to Government, Federated Malay States, for 1926, contains some interesting details of progress made during that year in respect of railway matters. The receipts from all sources were £2,524,730, an increase of 15·46 per cent., whilst expenditure chargeable to revenue on all accounts amounted to £1,774,861, an increase of 8·87 per cent. The net receipts for the year's working, therefore, amounted to £749,868, as compared with £556,536 in 1925, which represented 3·23 per cent. on the capital expenditure, as against 2·39 per cent. in 1925.

The number of ordinary passengers carried was 14,555,190, as compared with 12,552,621 during the previous year, representing an increase of 15·95 per cent. The total receipts from passengers showed an increase of 29·56 per cent. The receipts from goods traffic rose by 3·24 per cent.

A system of train control introduced in 1922, over a busy section of the line covering 105 miles, proved very satisfactory in controlling the movement of rolling stock, checking unnecessary haulage, and, in cases of breaches on the line, expeditiously restoring communication. With the introduction of this system, the number of telegrams has been considerably reduced. The system has been extended, and now controls the main line between Ipoh and Seremban.

New work went on satisfactorily. On the Kelantan section the line was opened as far as Kuala Krai—53 miles—and platelaying was completed as far as the seventieth mile and from the 76¼ to eighty-second mile, besides 3 miles near the Pahang boundary. Work on the Pahang section was reopened at the beginning of 1924, and good progress has been made.

The new engine and carriage sheds and goods yards at Seremban were completed, and work progressed on the goods and marshalling yards at Ipoh. Good progress was made on the Klang River bridge. Work is well advanced on the doubling of the line at Batu Junction to Kuala Lumpur. The work on the tunnel at Kuala Lumpur, which was commenced in 1924, is nearing completion. Progress has also been made on the earthwork and bridge for Victory-avenue.

A RUBBER RECOVERY FACTORY IN FRANCE

THE Commercial Counsellor at Paris—Mr. J. R. Cahill—has informed the Department of Overseas Trade that, according to reports in the Paris Press, the Société Française de Caoutchouc Récupéré has recently acquired, in the neighbourhood of Muizon, near Rheims, a factory that was built after the war as a twisting mill. This factory has been transformed to serve for the making of crêpe rubber from rubber scrap by the "Reno" process. It is stated that the daily production, which at present exceeds 100 kilos. of crêpe, will be increased to 2000 kilos. by the month of September, when new machines now on order have been brought into operation.

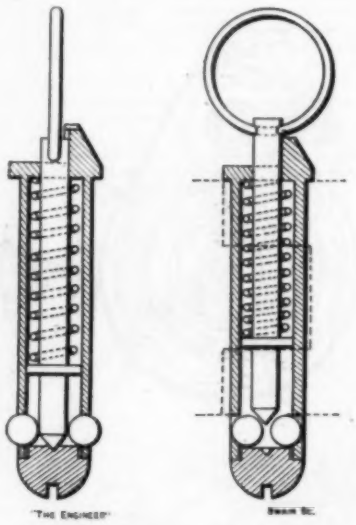
The following description of the "Reno" process is given. Scraps of old tires, which at present possess no commercial value, are thrown into vats containing a special solution—the composition of which is not specified—and remain there for fifteen to twenty days. During the immersion all the fabric becomes separated from the rubber and is converted into glucose. The rubber is then plunged into washing machines, where it is subjected to the action of acids, swells, and assumes the appearance of tripe. It is next passed through cylinders which crush and tear it, dried under vacuum for about an hour to extract superfluous moisture, and finally passed through a series of rollers, whence it emerges in the form of an elastic crêpe which, it is claimed, possesses all the properties of plantation rubber.

The works have been designed to embody modern methods for increasing efficiency. For the moment the early stages of the process are conducted in wooden casks, but they will be replaced shortly by large vats with a capacity of 25 cubic metres—5500 gallons—each installed under a hangar to admit of the dispersal of the gases given off. The washers are to be in close proximity to the soaking vats, and a Decauville railway system will convey the washed rubber to the crushers, the drying chambers and the rolling mill successively. The water that runs off after the washing stage in the process, is discharged into vats where the acid is recovered, and subsequently passes into huge sunken pits dug in sand, where any remaining acidity is neutralised by chalk. The water that is discharged after the crushing stage is treated for recovery of the glucose.

The factory has its own sawmill, which provides all timber needed for packing-cases, and a waterfall which furnishes the means of generating all the electric power required, as well as the water for the washing process. It is estimated that the product of the works can be sold at prices lower than those prevailing for similar qualities of plantation rubber, and that the market, which at present experiences difficulty in securing sufficient supplies, can fully absorb the quantity to be produced when the mill is running at full production.

A Quick Release Device.

A SIMPLE yet ingenious quick release and locking bolt has been brought to our attention by the inventor, Mr. G. W. Rice, of 24, Orchard-road, Hayes, Middlesex. This device should find some application in the aeronautical industry and in other directions where it may be required to provide a means of rapidly connecting or disconnecting parts which in the connected state have to be secured or locked against accidental disconnection. Security of connection and rapidity of disconnection must always, it would seem, be incompatible, but in Mr. Rice's device the



THE RICE QUICK RELEASE DEVICE

two have been allied with a very considerable measure of success. In the engraving the bolt is represented as forming the pin of a hinge or similar element. The bolt is hollow and contains a spring-pressed plunger provided with a ring at one end and pointed at the other. The pointed end of the plunger is designed to engage with three steel balls which can project through three holes at the foot of the bore in the bolt, the holes being smaller in diameter than the balls so as to prevent the latter from falling out. When the bolt is in its lowest position, as shown on the left, the balls project ⅛in. beyond its surface. In this position they rest against the plunger at a point above its tapered end and no amount of pressure on the balls will force the plunger upwards. The bolt in this condition cannot be withdrawn from the hinge unless the hinge sockets are ¼in. or more greater in diameter than the bolt. To withdraw the bolt a sharp pull is applied to it at the ring. The plunger is thereby lifted and the balls are left free to move radially inwards, thus permitting the bolt to be withdrawn. The plunger may be held in the raised position by rotating it through 90 deg. relatively to the bolt. In this condition the ring, as shown on the right, rests upon an upstanding lip on the bolt head and leaves the balls in the collapsed condition. A sharp pull on the ring is therefore sufficient to leave the balls free to retract. The same pull results in the bolt as a whole being withdrawn from the hinge or other sockets.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

SUPPLY AND DEMAND.

Sir,—Perusal of your editorial on "Supply and Demand" in The Engineer of July 8th, suggests that the thought might have been carried further as to the ultimate effect of the extension of the uses and possibilities of electric power.

As to the larger developments, you are right in suggesting that the heavy machine industries can also be developed or benefited. Since electric power has been shown to be suitable and economical for the operation of rolling mills, printing presses, wholesale bread-baking plants, cranes, dredgers, conveyors of all kinds, and innumerable other machines, the production of such machines has been developed, the design has been modified and the use has been increased, since in many cases no other source of power would be desirable.

As a concrete instance, with no joke intended, the persistent publicity as to the varied uses and advantages and possibilities of concrete has worked an enormous development in the Portland cement manufacturing industry. And this development has been distributed down the line among makers of engines, mills, kilns, and the host of machines and appliances used in connection with this one industry.

One cement manufacturing company has recently gone to the expense of building its own harbour, so that it may receive limestone in steamer loads of 10,000 to 15,000 tons instead of by trains of railway cars with 50 to 100 tons per car. At this harbour some of the steamers put their cargoes ashore with their own power and conveyor equipment. Others are unloaded by a great travelling gantry, which spans the stone stock-yard and carries a grab bucket to pick up 10-ton loads in the hold of the vessel. A large belt conveyor, nearly half a mile long, carries the stone to the cement works. All the machinery is electrically driven. And all of the machinery, with the numerous appliances involved, as well as some of the steamers, were ordered for this one of many cement works solely as a result of the vast and varied uses of concrete. Similar results have attended the popularising of agricultural machinery as a practical and economic development.

As to the smaller and household appliances which the electric industry is popularising in various ways—and the gas industry is working along the same lines—here is an example of equipment used by a small family in a small house in a residence town of 5000 population, which is served by a long-distance transmission line. Incidentally the city uses the current for street lighting and water pumping.

The house in question is, of course, wired throughout for electricity, as is customary. It has fixed lights throughout, some of them controlled from distant points for convenience. Some of the other electric appliances in regular use in this one residence are as follows:—

Portable lamps on tall standards for reading and on short stands for table use. Also portable or detachable bed-head lamps for use in case of sickness or the pleasure of reading in bed. Wall connections provide for different locations of the lamps.

Electric buzzers to call persons to come upstairs or downstairs.

An electric refrigerator, which eliminates the mess and trouble of having cake ice delivered daily or frequently for the ordinary ice box, as a necessary protection of food during the summer.

An electric clothes washer and wringer.

An electric clothes ironer (roller type).

An electric dish washer.

Electric flat-irons.

Electric carpet sweepers.

Electric heaters (reflector type) for placing in any room during cold days of spring and autumn when the regular heating system is out of commission.

Electric heaters (pad type) as a happy substitute for hot-water bottles in case of sickness, headaches, &c.

This small family establishment is but one of millions, and there are many other appliances which it does not possess. As a result of these popular uses of electricity, consider the great manufacturing plants and the thousands of workmen required to produce the machines and appliances, the machinery for the electric generating stations, and the machinery to build the household machines and the manufacturing and generating plants. The ramifications are almost endless, and the large machine manufacturing industry is not one of the least to be benefited in this way. American Electricity.

August 16th.

RECENT EXPRESS LOCOMOTIVES.

Sir,—Your leader comparing the characteristics of the three latest larger locomotives on the Southern, Great Western and L.M.S. railways was undeniably interesting, as are all steam locomotive comparisons, varying as they do at the will of their designer more than in any other branch of prime mover practice at the present day, and yet in total depart so little from the original type.

Your comparison of basis factors of design, when such can be discovered, does seem to indicate that more driving wheels are required for engines sufficiently powerful for the duties, now called for, of hauling trains of over 500 tons weight up gradients of 1 in 75 without assistance.

A locomotive with a grate area—surely the real basis factor of comparison of capacities—of over 40 square feet should have four axles when grates of 30 square feet have apparently—as you note for the G.W.R.—great difficulty in absorbing their power in three axles, and if turntables limit the total length of engines, then the 2–8–2 seems one way out of the difficulty. Three-cylinder express engines of this type are running in Germany.

As to the results from compound engines, they appear to be excellent, and that sufficiently large low-pressure cylinders could not be got on to the new L.M.S. engines seems to be the reason why this principle was not adopted by Sir Henry Fowler in this case.

One other point out of the many that there are relates to the size of driving wheels. Why go above 6ft.? The use of high-value materials means light weights for the moving parts, so that even with such size wheels there are less inertia forces than occurred with ordinary steel, &c., with 6ft. 9in. wheels. Furthermore, a 6ft. engine will do for both express goods and passenger trains, and thus saves a type.

The development of the large three-cylinder compound, with still higher pressures, will be interesting no doubt, with a separately controlled cut-off gear for the high-pressure cylinder, but how the large low-pressure cylinder difficulty will be got over without a tandem arrangement is still a problem for the ingenious chief mechanical engineers of our railways.

August 17th. Rocket.

Sir,—Your interesting article on "Recent Express Locomotives" in the current issue makes comparison of the three new 4–6–0 designs with the first passenger engine of that type in this country, the old N.E.R. class of 1899 in respect of dimensions. This historical comment may perhaps be extended by noting that four years later, in 1903, the late G.N.R. introduced their large "Atlantics," the boilers of which had 2500 square feet of heating surface and 31 square feet grate area, figures very closely allied to those now attained in the three new designs referred to.

These have the advantage in boiler pressure and are provided with superheaters with which the G.N.R. "Atlantics" are now all fitted, but the fact that the latter type, though twenty-four years old, is daily taking on the former G.N. main line loads appreciably in excess of those handled on their easier main line from London to Crewe by existing L.M.S. classes prior to the new 4–6–0's, is evidence of the soundness of the boiler proportions of the "Atlantics."

The value of the comparative evidence of coal consumption per draw-bar H.P. for which you plead might perhaps be further enhanced by the inclusion of data relative to late G.N.R. "Atlantic" type.

August 16th. A. F. L.

CENTENARY OF FIRST RAILWAY IN FRANCE.

Sir,—I have delayed reply to Mr. F. W. Brewer's letter of July 15th, while obtaining information from original sources to answer his first question.

I now have to thank Monsieur Ferdinand Achard for the following facts:—Verpilleux patented his steam tender in November, 1842. The first locomotive had its boiler tested in June, 1843, but this boiler exploded. The locomotive with reconstructed boiler, which is shown on the drawing exhibited at St. Etienne is correctly dated 1844.

Regarding Mr. Brewer's second question, it is correct to say that the Stephenson intermediate position for outside cylinders was first revived in England by Webb in his three-cylinder compounds, which, by his own statement, were derived from Stephenson and Howe's three-cylinder rear-driven engine of 1845. Drummond, probably following Webb, again revived it for his 4–4–0 engines with independent drive, but both these types are obsolete.

Drummond also applied it to some 4–6–0 engines, but these are, I believe, obsolescent, and have no living descendants.

In France this position, which is very common, was first derived from the Crampton locomotives on the Est Railway, and not from Stephenson's rear-driven type as I once supposed. Monsieur Achard has convinced me on this point.

Although the de Glehn compound La France is not a lineal descendant from the Crampton's, it seems correct to say that the intermediate position for the cylinders, so far as it appears in Great Britain in any live design, has been derived from that engine and survives in the four-cylinder types of the G.W.R.

August 12th. J. G. H. Warren.

INTERNATIONAL CONGRESS FOR TESTING MATERIALS.

As previously announced, an international Congress for Testing Materials will be held at Amsterdam from September 12th till 17th next.

The subjects to be treated at the Congress are divided in three sections:—(*a*) Metals; (*b*) cement concrete, stone and bricks; and (*c*) miscellaneous, (oils, rubber, wood, &c.).

In each section twenty-seven papers will be presented in English, French or German, but in view of the limited time the speeches will not be translated during the sessions, though the proceedings, containing the papers in full and a summary of the discussions, will be published in two volumes at the price of 20 guilders.

A few weeks before the opening of the Congress the programme will be forwarded to those participating in it. This programme will contain general information, a list of the papers with the names of the authors and a synopsis of each paper An illustrated guide of Amsterdam will be attached to the programme.

During the Congress a trip by boat to the new sea locks under construction at the harbour of Ymuiden, will be arranged, and at the end of the Congress an official banquet is to be held at Scheveningen, near The Hague. The meetings of the Congress will take place in the University of Amsterdam, and during the Congress an exhibition of materials of the Dutch Colonies will be held at the Royal Colonial Institute at Amsterdam.

The fee for those participating in the Congress is fixed at 10 guilders, while lady participants will be charged 5 guilders. Further information may be obtained on application to the secretary the International Congress for Testing Materials, Valckenierstraat 2, Amsterdam.

INSTITUTION OF PUBLIC LIGHTING ENGINEERS.

The annual Conference of the Institution of Public Lighting Engineers is to be held at Brighton on September 12th, 13th, 14th and 15th next. The following programme has been arranged:—

On Monday, September 12th, there will be a Council meeting in the Royal Pavilion at 6.30 p.m. At 7.45 p.m. members will assemble at the Exhibition, Corn Exchange, Pavilion Grounds, where a reception will be held by the Deputy Mayor of Brighton, Councillor J. Lord Thompson, who will afterwards formally open the Exhibition.

On the Tuesday, at 10 a.m., an official welcome will be given to the members and delegates by the Deputy Mayor. After the transaction of the usual business, the new President, Mr. Alex. C. Cramb, M.I.E.E., M.I. Mech. E., Electrical Engineer and General Manager, County Borough of Croydon, will be inducted and will deliver an address. A joint paper descriptive of the British Engineering Standards Association "Standard Specification for Street Lighting," will be then presented by Captain L. B. W. Jolley, M.I.E.E., Research Engineer, and Mr. J. M. Waldron, Research Laboratories, G.E.C., Wembley, and Mr. Robert Watson, member Institution of Gas Engineers, Engineer and Manager, Corporation gas department, city of Doncaster. In the afternoon there will be visits to the Brighton and Hove General Gas Company's works, Portslade, and the Corporation electricity power station, Southwick, or to sub-stations. At 7.30 p.m. the Institution dinner will be held in the banqueting room of the Royal Pavilion.

On the Wednesday, at 9.30 a.m., the President, with the Council and members, will place a wreath on the Cenotaph. At 10 there will be a resumption of the Conference, when a paper descriptive of the public street lighting of Brighton by Mr. John Christie, M.I.E.E., Engineer and Manager, County Borough of Brighton, electricity department, and one on "Road Traffic and Public Lighting, as seen by a Chief Constable," by Mr. R. L. Matthews, chief constable of Leeds, will be considered. The afternoon will be especially given up to inspecting the public lighting appliances from 2 p.m. until 5 p.m., when the Exhibition will close.

On the Thursday trips can be arranged to Boulogne, round the Isle of Wight, Southampton; or, alternatively, motor coach drives to Eastbourne, Worthing or Arundel.

MOTOR SHIP TRIALS WITH EXHAUST-TURBO SUPERCHARGED ENGINES.

At the beginning of last month successful speed trials were run in the Bay of Danzig by the two motor passenger vessels Hansestadt Danzig and Preussen, which have been built for service in the Baltic Sea between Swinemünde, Danzig and Pillau. The ships were built by the Stetting-Oder Works, and the Vulcan Works, of Stettin, respectively, and are propelled by twin-screw ten-cylinder Vulcan-M.A.N. oil engines of the four-cycle trunk piston type. The ships have a length of about 263ft., with a beam of 38ft., a depth of 22ft. 6in., and a measurement of about 2300 gross tons. The outstanding feature of their machinery installations is that they are designed to utilise high supercharging pressures, the air for combustion being delivered to the cylinders by blowers which are driven from exhaust gas turbines on the Büchi system. Each main cylinder has a diameter of 21 ¼in. (535 mm.) and a stroke of 23⅝in. (600 mm.). When running as an ordinary Diesel engine without supercharging, the designed output of each engine is 1700 S.H.P. at 240 r.p.m. During the trials with the supercharing exhaust turbo-blowers in action, a maximum ship's speed of 20·2 knots was attained, corresponding to a total for both engines of 8050 S.H.P. At this power the engines were running at 317 r.p.m., and a mean effective pressure of 118 lb. per square inch was recorded. If the normal mean pressure for an ordinary four-cycle marine oil engine be assessed at 67 lb. per square inch, then the full speed output of the supercharged engine referred to represents an increase of about 138 per cent. over the normal output without supercharging, this figure, of coufse, takes into account the increase in the engine speed. Making a similar comparison, the increase in the mean effective pressure is about 75 per cent. These results are especially good for engines of the high-speed submarine type, and even better figures may, we understand, be expected with slower speed motors. The trials would seem to show that increased outputs up to 45 and 50 per cent. over the normal rated output can, with the same cylinder dimensions and speeds, be obtained by exhaust turbo-supercharging, while it was also demonstrated that increases in power up to 75 per cent. could be easily sustained over quite long periods.

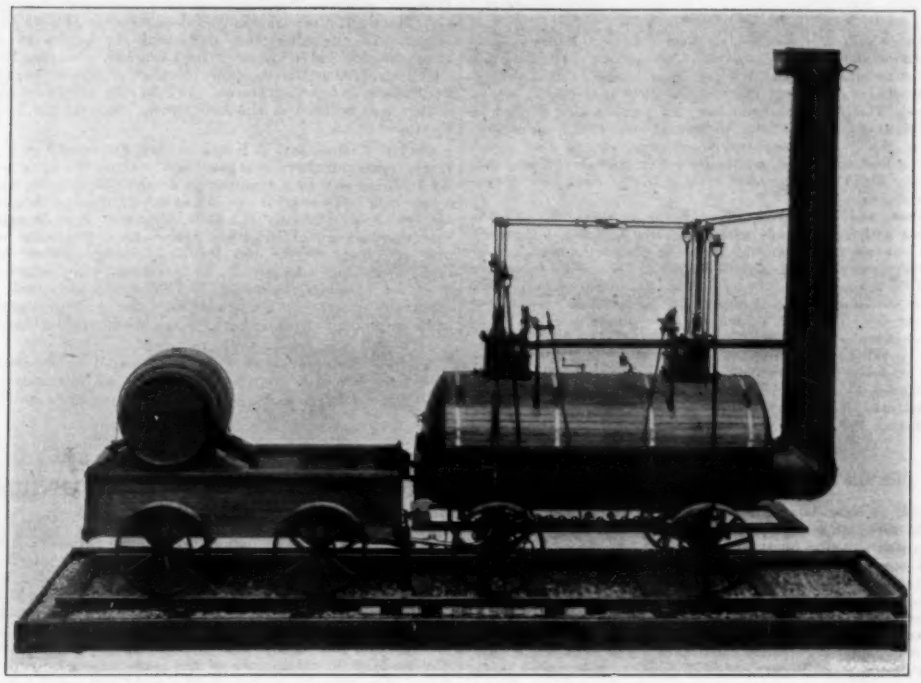
NEW CHICAGO WATERWORKS TUNNEL.

The city of Chicago takes its water supply from Lake Michigan by a series of tunnels extending 2 to 3 miles under the lake to intake shafts surmounted by cribs enclosing walls having gates opening into a steel cylinder which forms an extension of the shaft. A new tunnel now being driven will extend about 3 miles from shore, in solid rock, and at a depth of about 190ft. below the water surface, and 60ft. to 80ft. below the top of rock formation. The tunnel has vertical sides, a semi-circular roof and a slightly concave floor. For about half its length it is 16ft. wide and 16ft. high, the remainder is 13ft. by 13ft. With a flow velocity of 1ft. per second, the capacity is 140 million gallons daily for the larger and 92 million gallons daily for the smaller section. The rock is mainly solid limestone or dolomite, overlaid by shale or hard clay. In places, however, there are faults filled with clay, and as both the solid rock and the seams are wet, heavy timbering is required in some places as soon as the excavation is made. For loading the spoil, a drag line bucket, operated by an electric winch, pulls the material up an incline to a platform, from which it falls through traps into the 1-yard tunnel cars. There is a double-track line of 12in. gauge, on which trains of twenty to thirty cars are operated by 5-ton petrol locomotives. At the shaft the spoil is dumped into a hopper feeding 2-yard skips. From the land end of this tunnel about 8 miles of tunnel will supplement the present tunnels under the city to the several pumping stations.

Institution of Naval Architects.—The following scholarships have been awarded by the Council of the Institution of Naval Architects:—Royal Commissioners for the 1851 Exhibition Post-graduate Research Scholarship in Naval Architecture, 1927 £250 per annum, to Mr. L. C. Burrill, B.Sc., of Durham University (Armstrong College, Newcastle-on-Tyne); Institution of Naval Architects Scholarship, 1927, £130 per annum, to Mr. F. V. Cross, of Chatham Dockyard; Earl of Durham Prize to Mr. V. W. Hall, of Portsmouth Dockyard.

MODEL OF STEPHENSON'S KILLINGWORTH LOCOMOTIVE

MADE BY TWINING MODELS, LTD., NORTHAMPTON



George Stephenson's Killingworth Locomotive.

Amongst the recent additions to the Science Museum collections, one of the most interesting is a working model, to a scale of 1 : 8, of one of the early locomotives built by George Stephenson while he was employed as engine-wright at the Killingworth Colliery, near Newcastle. The model has been made by Twining Models, Ltd., from drawings prepared in the Museum, and it is based on George Stephenson's early drawing which was acquired by the Museum in 1923.

While George Stephenson built his first locomotive in 1814 and several others between that date and 1822, no illustrations of them—except the crude patent drawings of 1815 and 1816—appear to have been made until William James published a small sketch of one in 1823. Nicholas Wood, in 1825, published the story of George Stephenson's early work, but except for a sketch of the gearing of the 1814 engine, he illustrated none but later engines. It was thus only after the discovery of the above-mentioned drawing that sufficient information became available to render it possible to construct a representation of the earliest efforts of this famous pioneer, who, while he was not the inventor of the locomotive, yet did more than any other man to bring it into practical use.

The model, which is illustrated by the accompanying engraving, works by compressed air, and is mounted on friction wheels through which the tender wheels are rotated also. It measures 39in. long and 28in. high. It represents the type of locomotive patented by George Stephenson in February, 1815, possibly the actual engine made in that year, but if so, after its reconstruction in 1816 or 1817, when the original cranked axles and coupling-rods were replaced by a chain and sprocket wheels.

The prototype had two vertical cylinders, 9in. diameter by 24in. stroke, both placed on the centre line, half sunk in the boiler, to which they were attached by large flanges. Their centres were 7ft. 2in. apart. The four wheels were of cast iron, 37in. diameter, with ten straight spokes, and the axles revolved in ordinary plummer blocks bolted to the underside of the open cast iron frame, which was 13ft. 4·5in. long, 3ft. 7in. wide and 8in. by 2in. section. The front bearings, however, were provided with long bases having slotted bolt holes, and screwed studs projected horizontally from one end. These screws passed through lugs fixed to the frame, and nuts on both sides of the lugs served to move the bearings of the front axle so as to adjust the chain when necessary. The chain was made up of hollow cylindrical rollers connected together by pairs of side links, the end pins of which passed through the rollers. The rollers fitted into semi-circular spaces between the sprocket wheel teeth and the side links embraced the teeth. The chain was adjusted on the sprockets, so that the cranks on the two axles stood at right angles to one another.

The crossheads were guided by four flat bars, two at each side, bolted to lugs projecting from the cylinder, and from each descended a pair of long slender connecting-rods to crank pins attached to one spoke of each wheel, the pins at each end being spherical. The rods had one-piece box ends, with wide gaps for the insertion of the brasses, which were secured by gibs and cotters. The guide bars were stayed together at the top, transversely and longitudinally, and also to the chimney.

The valve chests were placed towards the centre and the slide valves were driven by loose excentrics on the axles through excentric rods, bell-crank levers, gab-ended vertical rods and rocking levers. Starting or reversing were effected by disconnecting from its vertical driving rod the valve of the cylinder whose crank was in the most favourable position. The valve was then worked by hand until the engine moved in the required direction, while the other cylinder would come into action when its excentric was caught up by the driving pin on the axle. The exhaust steam was led to the chimney by a single pipe of 4in. external diameter.

The boiler had a cylindrical wrought iron shell, 4ft. 6in. diameter by 10ft. 10in. long, with two dished ends, which made the overall length 12ft. This was traversed by a single flue, 25in. inside diameter, in one end of which was the grate, while the other end was joined to the chimney, which was 18ft. 8in. high above the rails and 19in. diameter at the top. A revolving cowl or smoke deflector was fitted to the top of the chimney. The heating surface was about 80 square feet and the grate area 7 square feet, the steam pressure was 50 lb. per square inch. The boiler was supported on four cast iron feet bolted to the frame, and was lagged with wood so far as the tops of the feet. Its centre was 4ft. 9in. above the rails. The regulator was placed inside the barrel with its operating handle on top, where was also a weighted lever safety valve. A high footboard for the driver was provided along each side of the boiler. The feed water was supplied by a long-stroke feed pump bolted to the right-hand side of the boiler and driven directly from the rear crosshead. Two cocks served to determine the water level. The length of the engine was 14ft. 10½in.

The tender, or convoy carriage, was a rectangular wooden truck, 10ft. 6in. long, to carry the coal, while at the rear end a water barrel, 4ft. diameter, was mounted on chocks and secured by iron straps. It was carried on four cast iron wheels, 37in. diameter, with a wheel base of 5ft. 1½in., and was closely coupled to the engine.

The engine weighed about 6 tons in working order and the tender 1·5 tons. The normal load was about 50 tons and the speed on the level was from 4 to 8 miles an hour.

The model is shown standing on cast iron fish-bellied rails of the pattern patented by William Losh and George Stephenson in 1816. These were 4ft. long and 6in. deep at the middle, and were connected by half-lap joints secured by pins passing through the rail ends and through the jaws of the chairs. The undersides of the rail ends, where they rested on the chairs, were made cylindrical, so that the sleepers might cant without disturbing the alignment of the rails. The chairs were spiked to wooden transverse sleepers.

The illustration is taken from an official photograph by permission of the Director of the Science Museum.

A Model for Demonstrating the Meaning of Power Factor.

The model shown in the accompanying illustrations has been designed by Mr. R. W. Adams, manager of the Providence office of the American General Electric Company, for the purpose of explaining the meaning of the term "power factor." It shows how the electro-magnetic inertia of a portion of an electrical system containing inductance increases the demand on the generating plant, and it also shows how capacity has the effect of reducing that demand. The model consists of a driving element, a belt and a driven element, all mounted on a base, as shown. The driven element has a fly-wheel and a spring-return mechanism, either or both of which can be connected to the shaft as desired. The mechanism constitutes a mechanical analogue of a typical electrical system, consisting of a generator, feeder, lamps, induction motors and some form of capacity. Actual visible pieces of electrical apparatus are not represented by the model, but only the internal and invisible electro-magnetic and dielectric structures which are responsible for the behaviour of the system under any set of conditions. In practice, the behaviour of the system is only made evident by instrument readings, which do not give a graphic picture of what is going on inside the apparatus itself. In watching the performance of the model the observer looks behind the scenes of an electrical system, much in the same way as a physician views the internal parts of the human body with the aid of X-rays. In general, the mechanical elements of the model correspond to the internal parts of an electrical system in the following way :—(1) Any element having friction corresponds to a non-inductive electrical circuit ; (2) elements having inertia correspond to an electro-magnetic circuit ; (3) elements with springiness correspond to a dielectric circuit ; (4) velocity of any part of the model corresponds to the rate of current flow ; (5) force exhibited at any part corresponds to electrical pressure ; (6) friction and windage correspond to resistance or a non-inductive load ; (7) inertia corresponds to inductance ; and (8) springiness corresponds to capacity.

To demonstrate the principle of a direct-current circuit, the thumb screws on the fly-wheel and winding drum at the rear of the driven shaft are released, and the crank is turned briskly in either direction. The operator will find that speed is attained at once, and that the speed produced depends upon the force exerted ; whilst if the hand is removed from the handle, the system immediately comes to rest. If the crank is suddenly stopped, no pressure is felt on the fingers. This corresponds to a direct-current generator carrying a non-inductive load when neither the current nor the pressure continues after the E.M.F. is

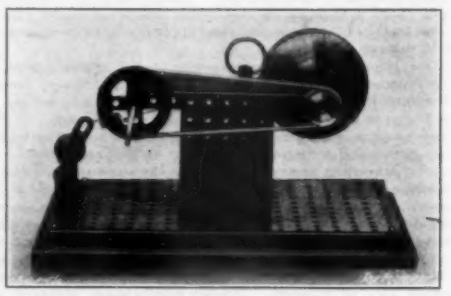


FIG. 1—FRONT VIEW OF MODEL

removed. If, however, the fly-wheel be firmly locked on the shaft by means of the thumb screw, it is found on turning the crank shaft that the mechanism comes up to speed more slowly, but that eventually the speed becomes uniform, in accordance with the force exerted at the crank. If the hand is removed, the system comes to rest slowly, whilst if the crank is suddenly stopped, a decided pressure is felt on the fingers and the system oscillates as it comes to rest, the period of oscillation being increased if a very elastic belt is used. This corresponds to a direct-current generator carrying an inductive load. Removal of the hand from the crank corresponds to removing the voltage from the line without opening the circuit, whilst forcibly stopping the crank corresponds to opening the generator switch under load. In the first case the current in the system continues to circulate in the same direction as before, and gradually dies down, no voltage appearing at the point of short circuit ; whilst in the second case the current tends to continue in the original direction, but dies down very abruptly. In the electrical case, a high voltage appears at the break, tending to maintain a current flow in the form of an arc across the air gap. A counter E.M.F. is set up, and the system oscillates, as it comes to rest, the period of oscillation being governed, in part, by the capacity of the feed cable.

Coming now to the alternating-current demonstrations

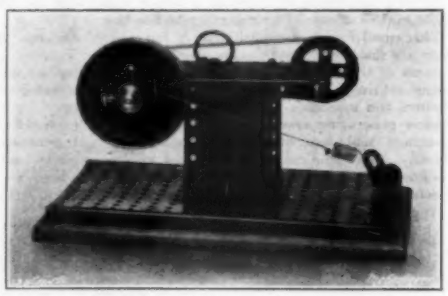


FIG. 2—BACK VIEW OF MODEL

with the fly-wheel still fixed to the shaft the crank shaft is oscillated evenly through 180 deg. at the rate of about one complete cycle per second. The effort required at each end of the stroke to reverse the motion is noted, and it is found that the fly-wheel does not get up to speed until some time after this effort is expended. The speed of the wheel lags behind the application of the force. This corresponds to an alternating-current generator dealing with an inductive load, such as a load of induction motors. Owing to the combined inertia of the magnetic circuits, the current lags behind the E.M.F., and considerable extra power has to be circulated in the system merely to reverse the magnetisation of these circuits. The crank is then adjusted, so that it points directly downwards, whilst the thumb screw points upwards and the spring anchorage lever arm is made to take up the vertical position. The crank is then oscillated as before, and if necessary the tension of the spring is adjusted. Materially, less effort is then found to be required to produce the same velocity as before, and the pressure on the crank coincides in point of time with the motion of the fly-wheel. The addition of the spring corresponds to the introduction of capacity into the circuit, thus bringing the line current into phase with the voltage, thereby lessening the demand on the generating station. On loosening the spring on the winding drum and on repeating the first alternating-current experiment, it is found that a great increase in effort is required, and there is more strain on the mechanism. This strain is duplicated in the electrical circuit, whenever it is

called upon to carry a highly inductive load, and it necessitates the use of heavier equipment throughout the system in order to enable the increased load to be carried without danger to the apparatus or detriment to the service.

Power factor is merely a mathematical expression which expresses the ratio between the effort required in the two last experiments, and a system is said to have a low power factor when the effort exerted by the generators is greatly in excess of that which would be needed if the magnetic inertia of the load were properly neutralised.

A rigid belt on the model corresponds to a short overhead feeder, whilst a very elastic belt corresponds to a long underground cable. By using a flexible belt, the visual effect of the out-of-phase condition is greatly increased. A close study of the action of the crank, will, however, reveal the fact that the actual torque required to reverse the wheel with a flexible belt is less than with a rigid one, this being in accord with the behaviour of the corresponding electrical systems.

It is said that the model has proved to be a considerable help to those who have to explain the meaning of power factor to electricity consumers, with a view to persuading them to install power factor correcting devices.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Quietude.

There is no sign of any quickening of activity in the iron and steel trades, and the Midland market remains exceptionally quiet. The first signs of the autumn demand may not be discernible for another month yet, production having been well abreast of current consumptive needs. The present slackness of trade is stated to be more marked than is usual at this season of the year. Whether that be the case or no the weekly iron market at Birmingham to-day produced very little business.

Pig Iron.

The tone of the pig iron market remains very flat, and Midland smelters, the bulk of whose output is sold for home consumption, are disinclined to follow the lead set by Cleveland blast-furnacemen and further reduce prices. A reduction of half a-crown per ton similar to that made in Cleveland, is stated to be out of the question, and up to the time of writing, though consumers of pig iron were clamouring for price concessions, local smelters maintained recent quotations. Many furnacemen, however, claimed to discern signs of weakening, and were withholding even the small orders they have been accustomed to give out of late. The market situation is likely to be affected by the changed outlook in the light castings trade accentuating the difficulties of the moment, and causing anxiety as to the disposal of output. In view of the expectation of an improved demand within the next few weeks, Midland furnacemen generally are trying to maintain the present level of prices. Unconfirmed reports of concessions on Northamptonshire foundry are prevalent. Sellers continue to ask £3 2s. 6d. at furnaces for No. 3, while Derbyshire houses adhere to the quotation of £6 7s. 6d. It is quite possible that some concession will be forced from local producers in the course of the next few days, but it is not likely to be as large as that granted at Middlesbrough, where continental iron has been successfully competing at 5s. per ton below Cleveland makers prices. Stocks in the Midlands have not accumulated to the same extent as on the North-East Coast, and smelters are not experiencing the same concern as to the placing of their output. However, at the moment, the pig iron market hangs fire awaiting expected developments.

Steel.

A steady demand exists for constructional steel, though orders are scarce for other descriptions. Constructional engineers are receiving a fair number of inquiries for small jobs, but the tonnage involved is not large. Some consumers are still endeavouring to secure price concessions, but there seems no prospect of this for some time. The basis of £7 12s. 6d. for joists and sections and £8 7s. 6d. for ship, bridge and tank plates continues unaltered. Boiler-plates are quoted £11 to £11 10s., and Staffordshire hoops £10 10s. at works. Small bars are a slow sale at £7 15s. as are mild steel billets at £6 10s. upwards. Continental joists can be bought at £4 11s. f.o.b. Antwerp. Billets are offered at £5 7s. 6d.

Scrap.

There is no demand for heavy steel scrap though merchants are offering material at £3 2s. 6d. delivered South Wales.

Finished Iron.

The Staffordshire manufactured iron trade is extremely flat with hardly any new orders coming in. Makers of marked bars are carrying on, and find a fair market for their production at £13 10s. The increased activity in the shipbuilding industry is proving beneficial to the Staffordshire chain, cable and anchor firms, and the local brass and copper trades. For the lower grades of finished iron, there is particularly no demand. Common bars at £9 15s. to £10 are undercut by Belgian iron, which can be delivered in the Black Country at £5 17s. 6d.—a tempting offer to nut and bolt and fencing makers. The lack of demand, however, applies to continental material as well as British. Mills engaged on rerolling are not particularly busy, and there is not likely to be any substantial improvement for some weeks.

Galvanised Sheets.

The galvanised sheet trade is moderately employed, and prices have recovered somewhat. Corrugated sheets of 24-gauge, which a week ago were sold at £13 17s. 6d. f.o.b., were at Birmingham to-day quoted up to £14 2s. 6d. The minimum acceptable appeared to be £14, and buyers who sought to do business at last week's figure were disappointed.

Production Figures.

Little pleasure is to be derived from a perusal of the statistics of iron and steel production in July. Industrialists hereabouts express some surprise that they are up even to present tonnage considering the slack market conditions which have ruled during the month, and they are anticipating a further reduction in output this month. It is interesting to compare July production with that of the two preceding months. The pig iron produced amounted to 645,800 tons, compared with 651,300 tons in June, and 720,100 tons in May. The production includes 214,000 tons of hematite, 213,000 tons of basic, 165,900 tons of foundry, and 23,000 tons of forge pig iron. The output of steel ingots and castings amounted to 682,900 tons in July, compared with 747,300 tons in June, and 884,600 tons in May.

New Industry for Black Country.

Extensive developments are projected by the South Staffordshire Mond Gas Company, Dudley Port, Staffordshire, which has recently been granted Parliamentary powers under which it will be able to manufacture and deal in chemical products hitherto exploited only to a limited extent in this country. The proposed new operations of the company will mean the introduction of a new industry into the Black Country, involving a big extension of the present works at Dudley Port and the employment of a large number of men.

Iron and Steel Preservative.

Among the new developments contemplated by the South Staffordshire Mond Gas Company at Dudley Port, is the manufacture of a paint which it is claimed increases the life of iron and steel, and in which considerable interest is being shown by local engineers. The manufacture of the derivatives of the present products dealt in by the company, follows extensive investigations by the research staff during the past three years. Consideration of the corrosive effect of acids and sulphur upon iron and steel work prompted the company to seek a paint with sufficient protective qualities to prolong the life of iron and steel structures, and after intensive research work, it was found that the employment of suitably prepared bitumens afforded improved protection. Bitumens are remarkably inert to chemical and atmospheric influences. By blending different varieties of bitumen and reducing them to the colloidal state, it was discovered that paints could be made which adequately protected iron and steel from corrosion.

Rolling Stock Industry.

Midland rolling stock establishments are comparatively well situated for orders, and continuous employment should be assured for some months to come. The contracts lately negotiated have been a timely reinforcement of engagements now in the course of completion. In both the carriage and wagon departments the present and immediate future position is satisfactory. Though the home railways are ordering sparingly, some of the most pressing deficiencies in their rolling stock equipment have been receiving attention, and Midland firms have had a share of the orders given out. Private wagon owners have provided little work of late, but overseas requirements have given cause for satisfaction, and a good deal of work on export account is at present occupying the shops. South Africa has provided a good deal of work for British makers of rolling stock lately, but American contracts have not come up to expectations, although some good orders have been secured.

Motor Engineering.

Further industrial expansion in the motor engineering industry is in progress in the Birmingham district. The Moss Gear Company, Ltd., of Aston, is erecting at Tyburn, Castle Bromwich, a factory covering 50 acres of land. The contract for floor and roof alone will be nearly £60,000. The firm are understood to have on their books orders amounting to upwards of half a million pounds. It is expected that the new factory will be completed early in the New Year, when work will be found for several hundred additional people. The great American motor-car companies and also those who manufacture commercial vehicles are now finding it more economical to have many of their parts made in England, and one of these firms recently placed an order in Birmingham for £7000 worth of goods, all of which would have been made in America but for the operation of the McKenna duties. The firm above referred to have on hand contracts running into six-figures, which were it not for the McKenna duties have would been carried out in America.

Heavy Motor Vehicles.

The regulations of the Ministry of Transport governing the construction of heavy motor vehicles are generally welcomed by makers and owners of such vehicles in the Midlands. The tendency has been for vehicles to become larger and larger, and motor body builders in this area, in common with those in other parts of the country, have had to conform to the requirements of their customers, though many of them were of opinion that having regard to the increase in road traffic a check should be placed on this tendency. They therefore view with approval the Ministry's regulations stabilising weight and overall length considering it in the interests of all concerned and imposing a hardship on none.

Edge Tool Trade.

The improvement in the edge tool industry in the Midlands recorded a month ago has continued to develop, though even at date employment is not what could be desired, and orders are not sufficiently numerous, or of such a magnitude, as to be regarded as satisfactory. The improvement coming as it does after a long spell of quietude is, however, appreciated. Manufacturers here are of opinion that stocks in the hands of merchants overseas are low, and that at no distant date their renewal will become necessary. Foreign competition is keen, but it is considered there is every prospect of the trade assuming a much amended position in the near future.

New Regulations in the Glass Trade.

The regulations recently introduced by the Home Office making it illegal to employ in the glass-making trade youths under sixteen years of age, and prohibiting night work by youths under eighteen, have caused considerable stir and much dissatisfaction in the Stourbridge, Brierley Hill and adjoining areas of the Black Country, where for many years the production of table and decorative glassware has been carried on. It is considered the regulations will prove very prejudicial to the success of the industry as it is claimed that to be an efficient glassmaker, a person must enter the trade when young. At the present time glassmakers have the greatest difficulty in getting boys, and it is feared that if the new regulations stand, and the only source they can draw upon is the youth of sixteen, they will find that the labour they require has already been absorbed in other industries, and is not available to them. Alderman Bradford, the financial secretary of the National Flint Glassmakers' Society, takes a very pessimistic view of the situation. He stated that "the industry is threatened with extinction, and unless there is an alteration of the law, glassmaking in this country will become a dead-letter." The new situation which has arisen certainly calls for serious consideration.

Unemployment.

The number of unemployed in the Midlands is on the decline, the latest returns showing a decrease of about 18,000. The total now stands at 153,505, as against 171,580 a week ago. Of the total, 72,743 are working short time or are temporarily "stood off" work. In the Birmingham area the latest figures give 27,236 as being unemployed, as compared with 24,091. There has also been an increase in the Coventry area, viz., from 6408 to 7488. The chief decline is in the Stoke-on-Trent area, where the figures have fallen during the week from 22,638 to 19,606.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

Reducing Industrial Smoke.

A DEVICE which, it is claimed, serves the dual purpose of preventing black smoke and economising fuel is the invention of Mr. W. E. Mellor, of Oldham. Successful results are said to have been obtained with installations in connection with steam-raising plant at a number of Lancashire cotton mills, the trials extending from several months up to a year in one instance. Statements as to the efficacy of the device have been made by the chief sanitary inspector of Oldham, Mr. G. Winterbottom, and by Dr. J. Low, also of Oldham. An essential feature of the invention is that the fire-hole door, instead of being hollow, consists of a solid plate having an air aperture provided through it in its upper half only, a cowl with an open base fitted at its inner side, and a three-sided canopy with open base arranged at its outer side, the aperture, cowl and canopy together producing a substantially inverted U-like path for the passage of the air from the exterior to the interior of the furnace, the air being pre-heated and caused to be directed in a downward direction on to the fire. An intense white heat is said to be created in the fore part of the fire and the black smoke resulting from the coal as it is fed on to the fire is thus consumed. It is claimed that by merely replacing the doors of furnaces the invention can be applied to existing plant.

A Cargo of Locomotives.

Fifteen locomotives and their tenders for India have been loading at Manchester docks during the past week on the Norwegian steamship Beldis, of 2406 gross tons, the vessel taking them on board by means of the 100-ton crane which she carries. The whole of the consignment has been made by Lancashire firms—ten by the Vulcan Foundry Company, Ltd., of Newton-le-Willows, and five by Nasmyth, Wilson and Co., Ltd., of Patricroft—ten of them being for service on the Assam and Bengal Railway and the remainder for the South Indian Railway. The Beldis is proceeding to Glasgow to take on board other locomotives for the Sudan Railway.

Round the Corner.

Optimism was the keynote of the address of Mr. G. W. N. Nicholls, at the annual meeting of Edward Wood and Co., Ltd., constructional engineers, of the Ocean Ironworks, Manchester. A year ago, he said, he expressed the view that trade would revive, and his opinion remained unaltered. He was more than ever convinced that, as a nation, we had turned the corner. Given a continuance of freedom from industrial troubles, he believed there were good times looming ahead for manufacturers generally. Discussing the firm's profit-sharing scheme, Mr. Nicholls said the profits available this year did not warrant a payment under the rules, but he hoped that with renewed effort on the part of all concerned, the profit next year would be sufficient to enable the directors to show their appreciation in a practical manner. The directors of Crossley Brothers, Ltd., gas and oil engine makers, of Openshaw, Manchester, have declared an interim dividend on the preference shares for the half-year ended June at the full rate of 7 per cent. per annum.

£20,000 Lift Contract.

Etchells, Congdon and Muir, Ltd., electric lift makers, of Ancoats, Manchester, have secured a contract,

amounting to nearly £20,000, for the supply of the passenger and service lift equipment of the new buildings being erected for Grosvenor House, Ltd., in Park-lane, London.

Non-ferrous Metals.

In the non-ferrous metals market the tin section is still suffering from the after-effects of the spurt of a fortnight ago. In spite of evidence of increased statistical strength, in the shape of a further reduction in domestic stocks of the metal, spot prices at the time of writing are nearly £3 lower than a week ago, a corresponding fall being registered in the case of forward metal. The direct cause of the renewed weakness is the lack of buying interest, coupled with a certain amount of uneasiness among holders. Up to last week-end values had held up pretty well, but in the early days of the present week the weakness was more apparent. Apart from moderate buying by the cable-making industry, there has not been much stirring in refined copper, and standard metal has lost ground to the extent of a few shillings per ton. Notwithstanding, there seems to be rather more confidence in the outlook in this section of the market. Conditions in the lead and spelter sections are much the same as they have been for some months. Industrial buying interest in both metals remains at a relatively low ebb, and prices are about where they were at the beginning of last month, the whole of the recent gains being wiped out.

Iron.

Business in the iron market is slow, but a certain amount of satisfaction is to be derived from the admission of sellers that the position is no worse than is usually experienced at this time of the year, one maker stating that so far, this month, the orders booked had been rather better than was expected. The fact remains, however, that buying is still largely a question of filling immediate or early needs, forward commitments being the exception rather than the rule. There is a generally hopeful tone among sellers that early in September some semblance of the customary autumn buying spurt will be witnessed. The most interesting development during the past week has been the reduction in pig iron by North-East Coast makers, making the price of Middlesbrough No. 3 for delivery in Lancashire 80s. 8d. per ton. Derbyshire makes at 75s. 6d. to 76s. and Staffordshire at about 75s. still, however, enjoy an advantage in this area. Scottish iron shows little change at 93s. and East and West Coast hematites are steady at 89s. to 90s. Bar iron is maintained for the time being at £11 per ton for Lancashire Crown quality, and £10 for seconds, but inquiry this week has been on a restricted scale, with actual buying of limited extent.

Steel.

The position in the steel market generally may be summed up by quoting the remark of a seller this week: "Where users find that one bar will do they are rarely ordering two." Buying for prompt delivery is being rigidly adhered to, and so far as contract bookings are concerned these are being left alone. The experience of some steel-rolling firms, however, is that small orders tend to increase in number, if not in size. This is attributed to the fact that more and more contracts are running out, and that users have no choice but to enter the market, if only on a hand-to-mouth scale. Prices remain firm for the time being from £11 5s. to £11 10s. per ton for boiler plates, £8 7s. 6d. for tank plates, £7 12s. 6d. for sections, and from £7 17s. 6d. to £8 12s. 6d. for bars. The market for galvanised sheets is in an uncertain condition, and although prices ranging from £14 and upwards have been mentioned this week in connection with 24 gauges, down to £13 15s. is said to have been the basis of business. Only a moderate trade in these is being done at the moment. Thin sheets are particularly quiet, but there has been no further change since the reductions of about three weeks ago. Offers of imported steel are meeting with a very slow market, and for the most part values are unaltered, although wire rods are slightly easier and steel bars and bar iron somewhat firmer. Current quotations for continental materials, for cash against shipping documents and including delivery to Lancashire users' works, are:—Steel bars, £5 15s. to £5 17s. 6d.; sheet bars, £5 6s. to £5 7s.; billets, £5 2s. 6d. to £5 3s. 6d.; Siemens plates, £7 10s.; Thomas plates, £7 3s. 6d. to £7 5s.; sections, £5 15s.; wire rods, £6 12s. 6d.; and Belgian bar iron, £5 16s. to £5 17s. 6d. per ton.

BARROW-IN-FURNESS.

Hematite.

The position in the West Coast hematite industry at present necessitates a careful distribution of output, but a feeling of moderate optimism as to the future prevails. During the holidays, when the steel works were idle, stocks of iron naturally accumulated, but it is practically safe to say that the present output is being fully dealt with, either by the recent starting of the steel departments or by demands on the part of consumers. Stocks do exist in the district, and if the demand increases in the next month or two, any accumulated stocks will probably be cleared before any more furnaces are put into blast. The iron trade is still quiet, and practically all orders are for material required to meet immediate use. On the part of buyers there still remains a hope that there will be further reductions in the price of iron, and should such reductions be made, orders for future delivery would probably be given. Time alone can prove what the future of the trade is to be. Naturally, in August, with holidays intervening, business is quiet. The steel departments are at work again, and at Barrow the rail, merchants, Siemens and hoop departments are all engaged. At Workington the steel works are in operation and the sleeper department is experiencing better conditions. There were recently shipments of pig iron from West Coast ports to continental and Indian ports, but up to the present no very heavy tonnage has gone from either Barrow or elsewhere. The iron ore trade is naturally a reflection of the iron trade in the district, as is not as good as it was a few months ago. Present conditions will obtain until more furnaces are put into blast.

SHEFFIELD.

(From our own Correspondent.)

Steel Trade Quieter.

After the rush of work in the steel trades which followed the settlement of the coal dispute, things are now back again to normal, or less than normal. Taking Sheffield as a whole, the volume of work on hand does not appear to be as large as it was before the stoppage. While confidence in a revival after the holiday period is still to be found, it is not as pronounced as it was a few weeks ago, and there are those who express the fear that the tendency of trade is a declining one. While inquiries are very numerous, only a small proportion of them lead to actual business. That there has been a considerable decline in the steel trade is shown by the figures of production for June, and again by those for July. In the former month, the output of steel ingots and castings in the United Kingdom fell to 747,300 tons, as compared with 884,600 in May. Unfortunately the decline was proportionately greatest in the Sheffield district, where the total of 76,000 tons for June showed a fall of 40,000 tons on the month. The national figures of production for July show a further drop to 645,800 tons.

A Departmental Review.

There is much idle plant at the heavy steel forges of Sheffield. There is not such a large call for forgings nowadays as there formerly was, owing to changes in engineering construction, especially the replacement of the reciprocating steam engine by other forms of motors. A fair amount of railway work is on hand, but the companies are limiting their orders to actual requirements, and none of the axle and tire plant is fully occupied. There is a shortage of work in the wagon building department. The tool trades are not in a satisfactory state. The Japanese market, usually a very good one for circular and hand saws, has been depressed for a considerable time owing to financial difficulties in that country, but this decline may be regarded as temporary. The trade in plantation tools is poor, a substantial reduction being shown in the demand from various overseas markets employing native labour. Reasons given for this state of things are depression in the countries affected, drastic reduction of rubber crops, and intense German competition in certain descriptions of tools, especially matchets. The motor and cycle industries continue to make a considerable demand for steel, but it is not up to the average of former years. It is reported that the home season for these vehicles has been comparatively poor, although the export trade in both motor and ordinary cycles has been maintained at a high level throughout the year. Only a moderate amount of employment is to be found in the file and edge tool shops, and, in the face of keen competition, prices are unsatisfactory. For engineers' small tools of the best qualities there is a steady call, part of the demand coming from foreign countries, but, generally speaking, orders for tools are small. A little work is being done for Russia, the orders being placed through indirect channels. In the stove-grate trade, much slackness exists. Changes of fashion have led to present-day grates containing much less iron than formerly.

Cutlery and Plate.

There is nothing very new to say about the cutlery and plate trades, which are still far from busy. There was a sharp decline of business early in the year, and not much recovery has yet been made in the majority of instances. A few firms, executing large contracts for hotels and steamships or having good connections with Colonial markets, are active. Those which rely mainly on general home trade are, however, slack, and some of the small makers, working on little capital, are finding it increasingly difficult to carry on until conditions improve. Large quantites of German cutlery are still being imported at low prices, and it is complained that the placing of a safeguarding duty of 33⅓ per cent. *ad valorem* upon foreign cutlery has not been of any material assistance to the Sheffield trade. The scissors trade has probably benefited a little, although, on the other hand, it is stated that German scissors have been offered at lower prices than those asked before the introduction of the duty. One suggestion put forward is that the foreign goods are being generally undervalued by the exporter, so that they escape a considerable part of the duty. One manufacturer states that the duty on scissors imported to Sheffield would have to be brought up to 100 per cent., and in many cases even 200 per cent., in order to bring the prices to the level of Sheffield goods.

Engineering Research.

Much research work of an engineering character is carried on at the Applied Science Department of Sheffield University, and several interesting developments are in progress at present. In the engineering department, the foundations are completed for a new oil engine, to replace a superheated steam engine, which was the first of its kind to be installed in this country. A concrete testing machine, the heavy castings for which have been made in Sheffield works, is being erected, and the machining and finishing work on it are being done in the University shops. The fatigue of metals and the effect of high temperature on materials are also being investigated, while apparatus has just been installed for research work in the production, on a commercial scale, of light oils for internal combustion engines, and on the low temperature carbonisation of coal.

New Nottinghamshire Colliery.

Reports are to hand of the excellent progress made in the sinking and equipment of the new Bilsthorpe Colliery of the Stanton Iron Works Co., Ltd., in North Notts. The work of development has been proceeding for two and a-half years, and it is confidently hoped that coal in economic quantities will be reached this month. The pit is sunk on the fringe of the Barnsley seam, with two shafts, each of 20ft. diameter, and is to be one of the best equipped in the country. The electricity is generated on the site by steam turbines, each capable of 1500-kilowatt output. The screening plant and washery are practically completed, and are of the latest improved type. The equipment of the pit is designed to deal with 4000 tons a day, or about 1,000,000 tons a year. The coal washer and plant is capable of dealing with 175 tons per hour. When the colliery is in full working order, 2000 men will be employed.

Railway Developments.

A good deal of railway enterprise is in contemplation in the district in which the new colliery is situated. A branch line is being laid from the Rufford Colliery Branch. The London and North-Eastern and the London, Midland and Scottish companies propose to lay a line to be known as the Mid-Notts Joint Railway, starting from near Bestwood, and running *viâ* Oxton, Bilsthorpe, and Ollerton to join the old G.C.R. branch line to East Retford, at a point to the east of Checkerhouse. This new rail route will be open for passengers as well as industrial traffic, and will tap a large and productive coal area, so that it has in it potentialities of great developments.

A Relic to be Preserved.

An interesting exhibit, presenting as complete a picture as possible of the old methods of making cutlery, is to be arranged in Sheffield by the Cutlers' Company. In Whiteley Wood—one of the city's parks—is an old water grinding wheel, known as Shepherd's wheel. For some time there has been a danger that this interesting establishment would have to be closed, on the ground that it did not comply with new factory regulations. The Home Secretary was approached on the matter, and he has decided that, as the wheel is to be retained as a public exhibit of the grinding of cutlery, as it was carried on for for many years, he is justified in allowing it to continue as it is. The tenants are not to be disturbed. In one portion of the wheel it is proposed to erect a reproduction of an old cutlers' workshop, so that the traditional processes of grinding and making cutlery, as in operation before modern ideas were introduced, will be preserved.

In the East Riding.

The Goole Urban District Council has on foot a scheme for widening and improving the bridge over the river Don. The Ministry of Transport has promised a grant of 50 per cent., providing the total cost is not more than £4400, and the West Riding County Council will provide 25 per cent. The Goole Council has decided to apply for a loan of the balance, £1100. At a meeting of the same Council, the question of approach roads to the great bridge over the Ouse at Boothferry was raised. The bridge, which is to cost £110,000, is now in course of erection, and it was stated that, although action was being taken in the matter of a road from the East Riding side, nothing had yet been done towards providing one from the Goole end of the bridge to the Airmyn-road. It was urged that it would be better and cheaper if the new road was made before traffic started passing over the bridge, and the Council agreed to write the West Riding County Council and the Ministry of Transport on the matter.

NORTH OF ENGLAND.

(From our own Correspondent.)

Disappointed Hopes.

The iron and steel trade in the North of England is again passing through difficult times. The anticipations generally held at the beginning of the year that a long period of steady activity would be experienced have not materialised. Certainly the year opened on a very confident hope, and it is a fact that the total tonnage of iron and steel sold under forward contracts reached a very high figure, but orders have not since come to hand in the expected volume to replace those which are being worked off, and manufacturers are showing some anxiety as to the outlook for the industry. Some expansion of business is expected, as many customers are understood to have bare stocks, and negotiations for autumn needs are becoming due. Ruling market rates, however, do not meet views of buyers, and with manufacturers markedly disinclined to lower the level of quotations, which already yield very little profit, where they are not actually unremunerative, there seems little prospect of extensive fall-of-the-year transactions. Business of a hand-to-mouth kind appears likely to continue until buyers and sellers are able to show more disposition to meet each other as regards prices. A disposition to regard continental competition as less keen is noticeable, but foreign material is still obtainable at substantially below figures named for the products of this district.

Cleveland Iron Trade.

The ironmasters sprang a surprise on Tuesday, the 16th inst., by announcing an all-round cut in prices. They have steadily affirmed that existing prices did not cover the cost of production, but they have seen trade steadily slipping from their grasp, and in a further bid to retain a hold on local and foreign markets they have decided to reduce prices to the extent of 2s. 6d. per ton. Thus the revised prices of Cleveland iron are as follows:—No. 1 foundry iron, 70s.; No. 3 G.M.B., 67s. 6d.; No. 4 foundry, 66s. 6d.; and No. 4 forge, 66s. per ton. This marks the full extent of the reduction to local consumers, but for orders from Scotland and abroad it has been agreed to make a further cut of 2s. 6d. for parcels of at least 500 tons. Thus export orders of 500 tons or more can now be based on No. 3 Cleveland G.M.B. at 65s. The announcement of this important reduction during the holiday week came as a great surprise.

Hematite Pig Iron.

Inquiries for East Coast hematite pig iron are, if anything, a shade better, and sales to home and overseas customers have been put through, but export buyers

as a rule stipulate for iron of special analysis. Production has been curtailed to an extent that promises necessity of withdrawals from makers' rather heavy stocks to meet current demand. Mixed numbers remain at 75s. 6d., and No. 1 quality at 76s.

Ironmaking Materials.

Business in foreign ore is at a standstill, consumers having heavy stocks, and considerable quantities to accept against old contracts. Sellers keep quotations nominally on the basis of best Rubio at 21s. per ton c.i.f. Tees, but it is difficult to ascertain on what terms contracts might be arranged. Durham blast-furnace coke of good average quality keeps at 19s. per ton delivered to consumers in this district, but sales are slow, users complaining that the figure named is too high.

Manufactured Iron and Steel.

With the exception of the plant of Bolckow, Vaughan and Co., Ltd., Middlesbrough, at which some urgent orders are being executed, all the steel works in the Cleveland district are closed down this week. Manufacturers are becoming somewhat uneasy as regards future prospects. Orders coming to hand are on nothing like a sufficient scale to keep plant in its present state of activity. Quotations are unaltered, but customers anticipate reductions in the near future.

Shipbuilding.

The output of new tonnage from Tyne shipyards continues at a rapid rate, and of four vessels launched during the past few days, one will be handed over to the owners two months earlier than the contract date. Unfortunately, the receipt of new orders is far below what is required to keep pace with the rapid construction, and unless the position changes considerably, work in the Tyne yards will show an appreciable decrease next year. Another new order is announced, this being for an oil tanker to be built by the Palmer Company for the Venezuela Gulf Oil Company, which has had several vessels built by the Jarrow and Hebburn firm. The engines will be constructed by MacColl and Pollock, Ltd., of Sunderland.

The Coal Trade.

Autumn requirements at this time of the year usually improve sales in the coal trade, but just now buyers seem intent on limiting their demands to the present. They forego forward business, in which sellers are prepared to participate only at current prices. Collieries are operating at a loss, and, rather than yield still lower prices, would further curtail output. In a few instances, such as in the coking coal section, where there are stocks, and also where buyers have suitable tonnage to fit an occasional turn, prices have been shaded a little. Generally, however, values are nearly the same as a week ago, despite the depleted trade. The coal in chief demand just now is for ships' use, and the collieries producing bunkers are steadily situated. Steam fuel, although in quiet request, is not in any excessive supply, and prices are not being shaded. Small steams are scarce at most collieries. Durham gas coal is continuing in slow sale. Coke shipments are heavy and likely to continue so for the next week or two. Gas coke is especially well disposed of, but the demand now shows a tendency to ease, and a smaller business is passing.

SCOTLAND.

(From our own Correspondent.)

No Change.

PRACTICALLY no change is noticeable in the Scottish steel, iron and coal markets. Business on the whole is most restricted, and there is little, if any, evidence of a change for the better. Inquiries for coal for export are said to be increasing, but so far as actual turnover is concerned, no progress is reported.

Keen Competition.

The appearance in the steel market of any specification gives rise to very keen competition in which the home production has little or no chance. Reports of a stronger tendency in continental prices have, it is said, caused a more hopeful feeling in local circles, but the disparity between local and continental rates for many products is so great that it would take a definite and considerable advance in the latter before a hopeful feeling could be more than a fleeting one.

Prices Compared.

In a recent article in the *Glasgow Herald* on the situation in the steel trade, a comparison between home and continental prices was given as follows :—

	Home delivery.	F.o.b. Glasgow.	Continental f.o.b. Antwerp.
Steel—	£ s. d.	£ s. d.	£ s. d.
Ship plates ..	8 2 6	7 12 6	7 0 0
Sections	7 12 6	7 2 6	4 10 0
Bars	8 12 6	8 2 6	4 13 6
Billets	6 15 0	—	4 5 0
Sheet bars	7 0 0	—	4 7 6
Basic pig iron ..	3 17 0	—	2 17 6
Cleveland No. 3 foundry pig iron	3 10 0	3 10 0	3 0 0

The continental prices for billets, sheet bars, and steel bars are now 1s., 2s. 6d., and 4s. 6d. per ton respectively below the prices ruling in August, 1913.

Steel.

Business in the steel markets continues more or less on a day-to-day basis. Consumers have for a considerable period been convinced that cheaper prices must be established, and will not anticipate requirements to any extent, and while the hand-to-mouth system of buying may keep works going to some extent, the position is insecure, and unsatisfactory. The lure of continental material in view of the prices given above must be particularly strong, but a definite move by home producers would probably go a long way towards restoring confidence. Meanwhile, unless British material is specified the home producer must stand a frail chance, and have to be content with small quantities for immediate delivery.

Steel Sheets.

Black sheet makers are comparatively well placed. Galvanised descriptions have been bought in considerable quantities, and further bookings to the end of the year are reported. Prices of the latter are inclined to harden.

Iron.

The bar iron works still report a scarcity of orders for iron and re-rolled steel bars, small steel bars, sections and hoops. Bar iron for export is quoted £10 10s. per ton, but a lower figure could be secured for a good specification. The home price of re-rolled steel bars has been reduced by 5s. to £7 17s. 6d. per ton, delivered Glasgow sidings.

Pig Iron.

The pig iron market has been a little steadier during the week. Stocks are good, and prompt delivery can be given. Foreign pig iron, however, can still be delivered here at a price several shillings per ton lower than the home quotation.

Coal.

Inquiries for Scottish coal have improved somewhat, and it is reckoned that prices have reached their lowest level, and will now commence to harden. Home requirements are growing as the season advances, and continental inquiries are expanding. Lanarkshire splints are very firm and bunker coals have been busier. Ells are slow. Fifeshire and Lothians steams have experienced better shipping demands, and considerable quantities of Ayrshire fuels have gone to the Irish market. The better demand for round coal has increased the supplies of washed materials, with a corresponding easing in quotations. Aggregate shipments amounted to 246,124 tons, against 215,592 tons in the preceding week and 150,008 tons in the same week in 1925.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

THE steam coal trade has not marked any real development during the past week. The tonnage position is certainly a shade better, as the week commenced with the number of loading berths which were unoccupied, being twenty-four, as against twenty-eight at the end of last week. This is some improvement upon what has been experienced of late, but it is a long way from being satisfactory. Many collieries are idle altogether or working intermittently, and owing to the losses which they are making their financial position must be a very precarious one. Returns of exports last week were most disappointing, as the total was only 297,381 tons, which compared with 346,957 tons for the previous week and 450,428 tons for the week before that. It will be seen that the decline is very considerable, and last week's figure is the lowest recorded for any week this year. The probability is, however, that shipments from now to the end of the year will not again fall to this very low level. There are indications that tonnage will be better, and certainly the view is held that orders held by exporters are more numerous for the end of this month and September loading, by which time some all-round improvement is looked for. The question is also being asked whether the situation in America will not before very long have some influence. It will be recalled that the strike in the American bituminous industry has been in progress over 4½ months. When the trouble broke out it was estimated that the stocks of coal in America amounted to approximately 80 million tons, since which time they have been reduced to about half that figure. Buying has been quiet, but it is reasonable to suppose that as the autumn approaches this will become more active. There is no actual shortage in America at the moment, but in the course of the next two months the position may become very different, and it will not be at all surprising to hear of inquiries being in circulation for coals from this country. It is to be hoped that should offers from this side be sought, exporters will not be caught as they were on a former occasion, when some of them made very substantial losses as a consequence. What happened was that all the leading undertakings received an inquiry for quite a modest quantity of coals for shipment to the United States, and when they submitted their quotations they found that the whole of their offers were accepted, with the result that there was a scramble for the tonnage that was available, and rates of freight rose to a figure never anticipated. The colliery companies also discovered that they had agreed to accept a much lower price for their coals than they could have got, had they any idea that the Americans intended buying on such a large scale.

Spanish Coal Decree.

Reference was made last week to the action of the Spanish Government issuing a decree which is calculated to affect very seriously the import of coals into that country. It is difficult to say what exactly will be the position, but it is safe to conclude that its application will be very injurious to the coal export trade of this country and South Wales in particular. Some exporters are not so pessimistic about it, and hold the view that some means will be found to circumvent the provisions of the new decree, but this has yet to be found out. The Spanish Government issued a decree in April last concerning the measures to be applied to various services, and consumers in the matter of the quantity of native coal which they were to consume, and it is thought that as the effect of that decree has not been so marked as is desirable, the present decree is intended to tighten up the situation. The view is certainly held that the Spanish coalowners have gained a great victory. All the news to hand shows that the whole idea of the new decree is to stimulate the use of native coals; in fact, to give the Spanish owners almost a monopoly. It will not, of course, be advantageous to consumers, and there is no doubt that importers in Spain will oppose the decree as vigorously as exporters on this side will do. The provisions of the decree are very comprehensive, and it looks as if the intention is to reorganise the whole of the coal trade in Spain. The importation and distribution of coal is fully covered. It is stated that all consumers, intermediaries and merchants, whether subject or not to the compulsory consumption of Spanish coal, are obliged to give notice to the State representative of all purchases of foreign coal. The information which has to be disclosed reveals that the proposal is to obtain the very utmost amount of information regarding operations in foreign coals. No steamers arriving with foreign coal can discharge, and trains loaded with foreign coal will not be able to move without the authority of the body set up to deal with the application of the decree. The whole question has been taken up on this side, and the Government has been kept fully posted with information to hand. Representatives of the Mining Association of Great Britain and of the British Coal Exporters' Federation were to have an interview with Board of Trade officials in London on Wednesday of this week, and hopes are entertained that the Government will adopt a very strong line of action.

Coal Trade Finances.

The reduction in exports and the low prices which have operated during the past two or three months do not augur well for the future wages of the miners employed. The results of the trade for May, June and July will be made known at the end of this month, and on them will depend the rate of wages which will be paid for the three months, September, October and November. In view of the unsatisfactory conditions which have existed, it is unlikely that there will be any alteration in the rate which has been in operation during the past quarter. The present rate is the minimum allowed under the 1926 agreement, that is, 28 per cent. above the 1915 standard rates.

Trimmers Dispute.

For some time past a dispute with reference to the boxing of coal, meal hours, and other matters has been in progress between the trimmers and shippers at Newport, and in the early part of this week work on vessels was interrupted. It was, however, announced on Tuesday night that a provisional agreement had been arrived at and that work was resumed immediately. The settlement provides for maintenance of the pooling system and the acceptance of an independent chairman, and a definite agreement to abide by his decision on disputed questions submitted to him.

Current Business.

Generally speaking, prices of steam coals have displayed no alteration during the past week. The tone of the market for prompt loading has continued quiet, but there is a slightly better undertone, but it will take some time for this to materialise in higher figures. Stocks are too heavy, and work throughout the coalfield is too irregular to admit of real improvement until the general demand expands to an appreciable extent. Large coals are certainly unchanged, and barely upheld, but smalls of the better grades are firm, because of the limited production. In fact, some of the best smalls command almost as much as some of the inferior large coals. The inquiry for patent fuel and coke remains rather on the inactive side, but pitwood is steadier, owing to the short supplies coming to hand.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

ELECTRICARS, Ltd., of Landor-street, Birmingham, asks us to announce that Mr. A. W. Reeves, M.I.M.E., has been appointed as its technical sales representative for the North of England.

MR. IAN S. OSBORN, the elder son of Mr. Fred. M. Osborn, of "Oakshaw," Endcliffe Hall-avenue, Sheffield, has joined the board of directors of Samuel Osborn and Co., Ltd., Clyde Steel Works, Sheffield. Mr. Osborn is a grandson of the founder of the firm.

MESSRS. MILTON, BELL AND RAMSBOTHAM ask us to announce that they have now given up their office in Liverpool, and that in future all their work will be conducted from their London office, 57-59, Victoria-street, Westminster. Mr. Milton is continuing his connection with Liverpool University as associate professor of dock and harbour engineering.

LAUNCHES AND TRIAL TRIPS.

PORT GISBORNE, twin-screw motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Commonwealth and Dominion Line, Ltd.; dimensions, 500ft. by 63ft.; 11,350 tons deadweight. Engines, two four-cylinder twin-screw oil; constructed by W. Doxford and Sons, Ltd., trial trip, August 4th.

BRIGIDA, oil tank steamer; built by Harland and Wolff, Ltd.; to the order of the Anglo-Saxon Petroleum Company, Ltd.; dimensions, 305ft. by 50ft. by 15ft.; 2700 gross tonnage. Engines, two sets of triple-expansion, 13½in., 23½in., 36in. with 27in. stroke; pressure 180 lb.; constructed by the builders; launch, August 11th.

BRITISH ENDEAVOUR, oil tank steamer; built by Sir W. G. Armstrong, Whitworth and Co., Ltd.; to the order of the British Tanker Company, Ltd.; dimensions, 394ft. 6in. by 50ft. by 27ft. 6in.; to carry 6400 tons. Engines, inverted, direct-acting, triple-expansion, 25in., 42in. and 70in. by 48in. stroke, pressure 200 lb.; constructed by the Wallsend Slipway and Engineering Company, Ltd.; launch, August 12th.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 18 6	—
No. 1 Foundry	3 19 0 to 4 2 0	
No. 3 Foundry	3 16 6	—
N.E. Coast—		
Hematite Mixed Nos.	3 15 6	3 15 6
No. 1	3 16 0	3 16 0
Cleveland—		
No. 1	3 10 0	3 7 6
Silicious Iron	3 10 0	3 7 6
No. 3 G.M.B.	3 7 6	3 5 0
No. 4 Foundry	3 6 6	3 4 0
No. 4 Forge	3 6 0	3 3 6
Mottled	3 5 6	3 3 0
White	3 5 6	3 3 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
„ „ Foundry	3 5 0 to 3 6 0	
(3) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 0	—
(3) Derbyshire—		
No. 3 Foundry	3 7 6	—
Forge	3 4 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 6 6	—
No. 4 Forge	3 5 0	—
Basic	3 7 6	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 9 6 (a) / 4 12 6 (b) / 4 16 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 15 0	10 10 0
Best	—	
N.E. Coast—		
Iron Rivets	12 5 0	—
Common Bars	11 5 0	—
Best Bars	12 5 0	—
Lancs.—		
Crown Bars	11 0 0	—
Second Quality Bars	10 0 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	11 10 0	—
Best Bars	12 5 0	—
Hoops	14 0 0	—
Midlands—		
Crown Bars	10 10 0 to 10 15 0	
Marked Bars (Staffs.)	13 10 0	—
Nut and Bolt Bars	9 15 0 to 10 0 0	
Gas Tube Strip	11 17 6 to 12 0 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	11 0 0
Ship Plates, ½in. and up	8 2 6	7 12 6
Sections	7 12 6 to 7 15 0	7 2 6
Steel Sheets, under 3/16in. to ½in.	10 5 0 to 11 5 0	
Sheets (Gal. Cor. 24 B.G.)	— £14 5 0 to 15 5 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 2 6	—
Angles	7 12 6	—
Boiler Plates	12 10 0	—
Joists	7 12 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 12 6	—
Soft Billets	7 12 6	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	
Billets	7 10 0 to 10 0 0	
Manchester—		
Bars (Round)	8 12 6	—
„ (Small Round)	7 17 6	—
Hoops (Baling)	11 0 0	11 0 0
„ (Soft Steel)	10 0 0	10 0 0
Plates	8 7 6	—
„ (Lancs. Boiler)	11 5 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Hard Basic	8 2 6 to 8 12 6	
Intermediate Basic	7 12 6	—
Soft Basic	7 0 0	—
Hoops	11 10 0	—
Soft Wire Rods	9 5 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 0 0	
Billets and Sheet Bars	6 10 0 to 6 15 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	14 0 0 to 14 2 6	
Angles	7 12 6	—
Joists	7 12 6	—
Tees	8 12 6	—
Bridge and Tank Plates	8 7 6	—
Boiler Plates	11 0 0 to 11 10 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/4½ to 18/6
Block Tin (cash)	293 10 0
„ (three months)	285 10 0
Copper (cash)	55 2 6
„ (three months)	55 8 9
Spanish Lead (cash)	22 16 3
„ (three months)	23 3 9
Spelter (cash)	27 16 3
„ (three months)	27 16 3
Manchester—	
Copper, Best Selected Ingots	61 15 0
„ Electrolytic	62 17 6
„ Strong Sheets	86 0 0
„ Tubes (Basis Price) lb.	0 1 0½
Brass Tubes (Basis Price), lb.	0 0 11½
„ Condenser, lb.	0 1 1½
Lead, English	24 10 0
„ Foreign	23 5 0
Spelter	28 2 6
Aluminium (per ton)	£107

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/4 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	7/6
„ „ 6 p.c. to 8 p.c. „	£22 15 0	7/3
„ „ 8 p.c. to 10 p.c. „	£22 7 6	6/6
„ „ Specially Refined		
„ Max. 2 p.c. carbon	£36 5 0	11/6
„ „ „ 1 p.c. „	£42 5 0	15/-
„ „ „ 0·70 p.c. carbon	£54 0 0	17/6
„ „ „ carbon free	1/5 per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£12 10 0	for home, £16 for export
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0	scale 5/- per unit
„ „ 75 p.c.	£19 5 0	scale 6/- per unit
„ Vanadium	14/3 per lb.	
„ Molybdenum	5/- per lb.	
„ Titanium (carbon free)	0/11½ per lb.	
Nickel (per ton)	£170	
Ferro-Cobalt	9/3 per lb.	

FUELS.

SCOTLAND.

(Prices not stable.)

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	13/6
„ „ Splint	15/6 to 17/6
„ „ Trebles	15/- to 15/6
„ „ Doubles	14/- to 14/6
„ „ Singles	13/- to 13/6
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
„ „ Jewel	15/6
„ „ Trebles	15/6
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	11/9 to 14/-
Screened Navigation	18/- to 19/-
Trebles	16/-
Doubles	14/9
Singles	13/6
Lothians—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/3
Trebles	16/- to 16/3
Doubles	15/3
Singles	13/6

ENGLAND.

(8) N.W. Coast—	
Steams	22/6
Household	42/6 to 58/6
Coke	23/- to 24/-
Northumberland—	
Best Steams	14/6
Second Steams	13/- to 13/6
Steam Smalls	10/-
Unscreened	13/- to 13/6
Household	21/- to 27/-
Durham—	
Best Gas	16/- to 16/3
Second	14/- to 14/6
Household	21/- to 27/-
Foundry Coke	19/- to 26/-
Sheffield—	Inland.
Best Hand-picked Branch	27/6 to 28/6 —
Best Selected House Coal	21/- to 22/6 —
Screened House Coal	19/- to 21/- —
„ „ Nuts	16/- to 17/6 —
Yorkshire Hards	16/- to 17/- —
Derbyshire Hards	16/- to 17/- —
Rough Slacks	9/6 to 10/6 —
Nutty Slacks	7/6 to 8/6 —
Smalls	3/- to 5/6 —
Blast-furnace Coke (Inland)	21/- to 22/-* —
„ „ (Export) f.o.b.	18/6 to 20/-

(9) SOUTH WALES.

Cardiff—	
Steam Coals:	
Best Smokeless Large	20/- to 20/6
Second Smokeless Large	19/- to 19/6
Best Dry Large	19/- to 19/6
Ordinary Dry Large	18/- to 18/6
Best Black Vein Large	18/- to 19/-
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/6 to 18/-
Ordinary Eastern Valley Large	17/- to 17/6
Best Steam Smalls	13/6 to 14/3
Ordinary Smalls	12/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	20/6 to 21/-
„ „ Smalls	16/- to 16/6
No. 2 „ Large	17/- to 17/6
„ „ Through	16/- to 16/6
„ „ Smalls	13/- to 14/-
Foundry Coke (export)	35/- to 40/-
Furnace Coke (export)	27/6 to 30/-
Patent Fuel	23/6 to 24/6
Pitwood (ex ship)	30/6 to 31/-
Swansea—	
Anthracite Coals:	
Best Big Vein Large	37/- to 40/-
Seconds	28/- to 32/6
Red Vein	25/- to 30/-
Machine-made Cobbles	42/6 to 45/-
Nuts	42/6 to 47/-
Beans	30/- to 32/6
Peas	18/6 to 20/6
Breaker Duff	8/- to 8/6
Rubbly Culm	9/- to 9/6
Steam Coals:	
Large	18/6 to 19/6
Seconds	17/6 to 18/-
Smalls	10/6 to 11/6
Cargo Through	15/6 to 16/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow (b) Delivered Sheffield. (c) Delivered Birmingham. * Official quotation for pig iron producers.

French Engineering Notes.

(From our Correspondent in Paris.)

Treaties and Trade.

The iron, steel and engineering trades have reached a stage of inactivity when hope is giving way to a feeling of pronounced pessimism, for in whatever direction we look there are only faint signs of hope and plenty of indications that industry will experience some difficulty in recovering under the burden which is now placed upon it. While the home consumption has fallen very low, there is no relief from high wages, and the additional charges imposed upon industry by social legislation, while manufacturers complain that they have to pay more than their fair share of taxation. It has long been affirmed that the only way to stimulate consumption is to bring down prices, but many mill and forge owners have lately been offering supplies at prices that would have been regarded as almost impossible a little while ago, and yet they have failed to secure orders of any volume. The truth is that there is no confidence in the monetary stabilisation as a means of reviving trade, and it is felt that the stabilisation must become generally effective before there can be any hope of capital giving the required impetus to industry. Meanwhile, the only factor in a possible early improvement appears to lie in the conclusion of the negotiations for a treaty of commerce with Germany, which have been in progress for a considerable time, and still seem far from reaching a final settlement. The French Government has been obliged to extend the original scope of the treaty by covering practically every kind of product, and giving to Germany the most favoured nation treatment, which means that German machines and other engineering productions will be admitted into this country under the minimum tariff. This treaty will probably be taken as a model for treaties with other countries, and will also serve as a basis for the negotiations now in progress with Great Britain. According to official statements, much greater concessions are being offered to Germany than were originally intended, from which it may be concluded that there will be increased facilities for carrying on foreign trade.

New Metro. Lines.

The extension of the Metropolitan Railway lines under the main boulevards in Paris has raised problems of construction which are said to present more difficulties than any that have yet had to be solved in the execution of the underground railway scheme. Two lines forming an extension of those from Auteuil and the Porte de Saint-Cloud are being carried under the boulevards between the rue Richelieu and the Place de la Republique. The difficulty lies more particularly in the presence of mains which have to be displaced or avoided, in the necessity of carrying out the work without disturbing traffic, and in consolidating the thoroughfare which is liable to sag while the excavation works are proceeding in a sandy and often waterlogged soil. Contrary to usual practice in Paris of constructing double track tunnels, there is to be a tunnel for each track, thus making four tunnels for the two lines. Six pits have had to be sunk for the construction of the first tunnel, but four of them will be suppressed in two months' time, leaving only a shaft in the Place de la Republique and another in the rue de la Douane. On the completion of the first tunnel the excavated soil will be conveyed underground to boats on the Saint-Martin Canal. The usual practice in Paris is to drive the tunnels as near to the surface as possible on account mainly of the water that is often encountered at shallow depths, but it has been found necessary to construct the tunnels under the main boulevards much lower, in some cases to a depth of 59ft., where precautions will have to be taken to prevent an infiltration of water into the tunnels. These will follow the line of the boulevards, which will rest upon concrete walls between them. The important station at the junction of the rue Richielieu and the rue Drouot, where the two lines from Auteuil and the Porte de Saint-Cloud will join the boulevards, is nearly completed. The length of the line is 1640 yards, thereby making 6560 yards of tunnel having a width and a height of 36ft. The work will be finished in two and a-half years. Another interesting work is the construction of a tunnel under the Seine to connect up the existing line between the Opéra and Pont-Marie with the one which will continue on the other side of the river to the Porte de Choisy. The tunnel is being driven through hard chalky strata at a depth of 16ft. below the bed of the river, and, owing to the infiltration of water through fissures, the work has to be done under compressed air. A steel liner will be built up inside the tunnel, and it will be imbedded in 3ft. of concrete, which will serve as the outer covering of a cast iron tube 24ft. in diameter. The length of the tube will be 750 yards. The quantity of iron to be used in the construction of the tunnel will be 9500 tons.

Motor Car Trade.

Except for two makers who are able, with their great resources, to dispose of a large part of their production in foreign markets, the situation of motor car firms generally is very unsatisfactory, and many of them are in a precarious condition, to the extent that the industry can only be put on its feet again by a vast system of reorganisation. A start has already been made in the case of some firms, whereby interests are amalgamated and economies are effected by a closer specialisation, but a considerable amount of capital will be needed to carry out the reforms which it is proposed to make in the industry. Some time ago it was stated that negotiations for the control of De Dion-Bouton by German capital had been suspended on account of the threat of prohibitive duties on foreign machinery under the new Tariff Bill, but, now that there is some hope of the Franco-German commercial treaty being signed, it is stated that the negotiations have been resumed by the Mercédès Company with a view of acquiring complete control of that old-established firm. The idea is to continue the manufacture of the De Dion-Bouton cars in France and to fit them with German engines. As all attempts at salving the business with French capital have failed, the only alternative to an acceptance of the German offer appears to be the final disappearance of a firm which stood out so prominently in the early history of the automobile industry.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

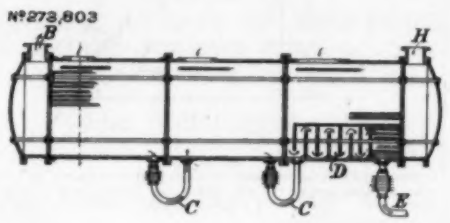
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

CONDENSERS AND FEED-WATER HEATERS.

273 803. April 7th, 1926.—Feed-water Heaters, The British Thomson-Houston Company, Ltd., Crown House, Aldwych, London, W.C. 2, and F. Samuelson, 44, Hillmorton-road, Rugby.

This feed heater is divided into three separate compartments, with the water tubes running through all three. The cold feed

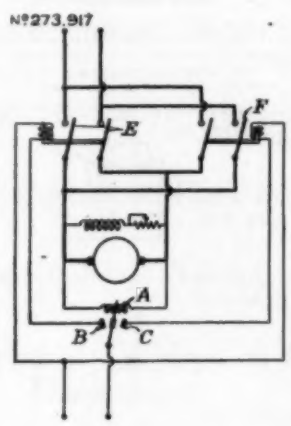


enters at H and the warmed water leaves at B. Steam from successive stages of the turbine is taken to the three compartments, the highest pressure being on the left. The condensate passes from one compartment to the next by the thermostatic drains C C, over baffles D, and is sucked out by the extraction pump of the main condenser at E.—*July 7th*, 1927.

TRANSFORMERS AND CONVERTERS.

273,917. August 14th, 1926.—Improvements relating to the Starting and Synchronising of Rotary Converters, George Burton Alvey and Roger Ernest Grime, and Mather and Platt, Ltd., all of Park Works, Manchester.

This specification describes an arrangement that ensures that a rotary converter has the correct polarity. A polarised relay

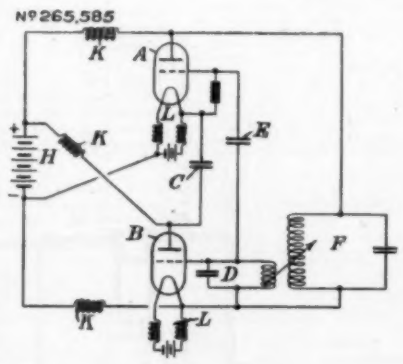


A is connected across the armature of the converter, and it controls contacts B and C, which, in turn, control solenoid-operated switches E and F, and it will be perceived from the connections that irrespective of the actual polarity of the armature, the machine will always be connected to the bus-bars with the voltage in the correct direction.—*July 14th*, 1927.

TELEGRAPHS AND TELEPHONES.

265,585. February 1st, 1927.—Improvements in or relating to High-frequency Signalling, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 9, Tempelhofer Ufer, Berlin, Germany.

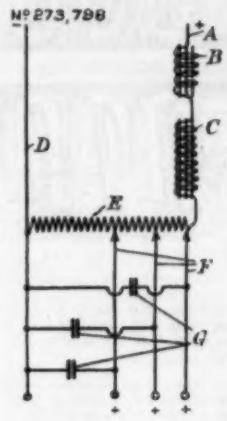
This invention relates to high-frequency signalling, and more particularly to signalling on short waves by means of thermionic



valves. According to the invention, the effective capacity of the valves is considerably diminished. Referring to the diagram, it will be seen that the valves A and B are connected in series through the condenser C for high frequency. Between the anode of the valve A and the cathode of the valve B is a working circuit D. The grids of both valves are connected together through the condenser E. The control voltage for the grid is generated by coupling an oscillation circuit F between the grid and cathode of the valve B with the working circuit D. Direct current for both valves is obtained from the battery H, and in the leads to the anode of both valves are chokes K, additional chokes L being inserted in the heating battery circuits.—*July 14th*, 1927.

273,798. April 6th, 1926.—A Device for Smoothing Electrical Currents and Reducing their Voltage, Frank Thornton, Ltd., of 1, Parker-lane, Burnley, and William Haigh Thornton, of 78, Albion-street, Burnley.

The positive lead A of the main supply is connected with two chokes B C, and with the negative lead D, through a resistance

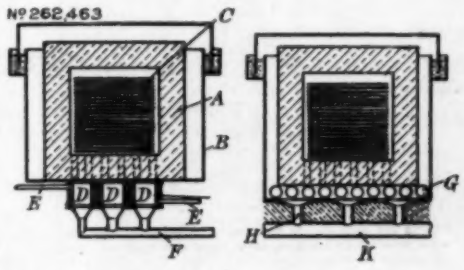


E, which may have any number of tappings F. From these tappings connections may be taken by a movable plug to the plate circuits of valves in wireless apparatus. From the negative lead D of the main supply to each of the positive tappings, a condenser G of high capacity is connected. Two other schemes are described.—*July 6th*, 1927.

FURNACES.

262,463. December 3rd, 1926.—Improvements in or relating to Electric Bright Annealing Furnaces, Siemens-Schuckertwerke Gesellschaft mit beschränkter Haftung, of Berlin-Siemensstadt, Germany.

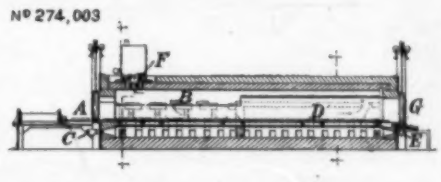
Electric bright annealing furnaces which, for the purpose of protecting the material to be annealed from oxidation and reducing the oxide layers already present are filled with hydrogen, but these furnaces suffer from the drawback that water vapour or steam is formed during the process of annealing, and during the cooling this steam again oxidises the material annealed.



According to this invention, this drawback is avoided. The electric furnace A shown in the left-hand drawing is surrounded by a sheet metal jacket or casing B, with a gas-tight joint. The annealed goods are shown at C. Under the bottom of the furnace there are cooling chambers D, which are cooled by means of a cooling coil E. The steam is condensed in these chambers, and the water formed escapes through the pipe F. The right-hand illustration shows a furnace with a cooling coil G mounted in the bottom, from which the water condensed escapes through the pipes H and K.—*July 14th*, 1927.

274,003. March 23rd, 1927.—Cementation Furnaces, *British Furnaces, Ltd., Derby-road, Chesterfield, and E. Woodhouse Smith, Allington House, Victoria-street London, S.W.* 1.

It is claimed for this furnace that it will perform the functions of a cementation furnace at less cost than that of the usual muffle type of furnace. To this end the material being worked is heated in an open furnace up to the temperature at which it will become liable to deterioration by the action of the pro-



ducts of combustion, and is then passed on to a true muffle furnace. The work is pushed into the furnace at the end A, and is given the preliminary heating in the section B by the heat produced by oil burners C. The muffle section D is heated by other burners E, and the whole of the waste gases escape by the flue F, so that there is no tendency for them to enter the interior of the muffle. The treated pieces are, of course, discharged from the furnace through the door G.—*July 14th*, 1927.

PUMPING AND BLOWING MACHINERY.

273,804. April 7th, 1926.—Centrifugal Pumps, Mather and Platt, Ltd., and R. Pennington, Park Works, Manchester.

This invention is adequately described in the following extracts from the provisional specification, while the illustration needs no comment:—"This invention relates to centrifugal, turbine and like pumps, and particularly to multiple-stage pumps of the turbine type having two or more impellers arranged in series. The object of our present invention is to provide simple and

efficient means for securing for the said pumps a stable head gallons characteristic such that at constant speed the maximum pressure occurs at zero output, whilst as the output increases the pressure remains constant or decreases gradually. By

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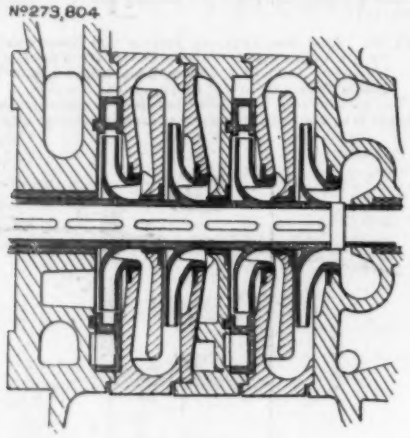

research and experiment we have found that by combining in one multi-stage pump unit stages of both the diffuser and non-diffuser type we are enabled to attain the object of our invention."—*July 7th*, 1927.

273,475. June 18th, 1926.—Cyclone Dust Separators, J. Keith and Blackman Company, Ltd., and G. Keith, 27, Farringdon-avenue, London, E.C. 4.

It is suggested that this type of cyclone dust extractor is less bulky and more efficient than the usual type. Its peculiarity lies in the fact that the upper part of the vortex chamber, into

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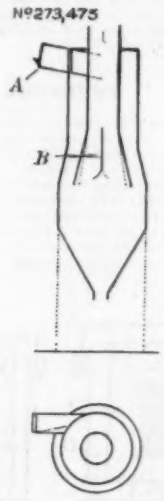

which the dust-laden gases are brought by the tangential duct A, is smaller in cross-section than the settling chamber. The outlet for the cleaned gases is brought well down into the settling chamber and is flared out to approximately the same diameter as that of the vortex chamber. In the mouth of the outlet there are baffles B for suppressing the rotational movement of the outgoing gases.—*July 7th*, 1927.

CRUSHING AND GRINDING.

273,499. July 12th, 1926.—Disintegrating Machines, H. J. Denham and H. Simon, Ltd., 20, Mount-street, Manchester.

In this pulveriser there are two shafts revolving in the same direction. On either shaft there is mounted a series of beater

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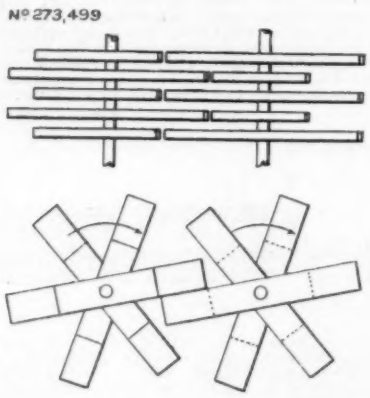

arms of alternate long and short radial dimensions. These arms intermesh, in rotation, in such a manner that the material being pulverised is acted on by both the tips of the arms and their sides as they pass one another.—*July 7th*, 1927.

MACHINE TOOLS AND SHOP APPLIANCES.

274,004. March 24th, 1927.—Power Press Guards, J. E. Senior, 145, Shardeloes-road, New Cross, London, S.E. 14.

This press tool guard is of the pendulum type and operates by swinging across the front of the machine as the tool descends. The guard itself is furnished with coiled springs A A on either side to provide a resilient buffer for the hand of the operator. The pendulum guard is pivoted on a bracket at B and is swung by the cross lever C which is connected with the tool ram by the link D. The link E, which joins the pendulum and cross

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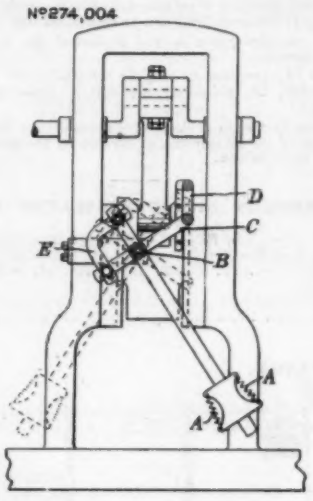

levers together, is provided with slotted bolt holes, so that the relative positions of the two parts may be adjusted.—*July 14th*, 1927.

METALLURGY.

273,855. April 29th, 1926.—Casting Steel Ingots, Sir R. A. Hadfield, 22, Carlton House-terrace, Westminster.

In this specification the principal claim is as follows:—As a step in the manufacture of sound steel ingots or castings from a normally finished heat of molten steel, testing a sample of such molten steel in a comparatively small mould formed of material—for instance, green sand—that will allow only of comparatively slow cooling of the sample, in order to determine whether such sample of steel is of a rising or settling nature, incorporating with the heat of steel, if the sample thereof be found to be of a rising nature, a deoxisiding agent—as, for example, aluminium or ferro-silicon—sufficient in quantity to convert the heat of steel into steel of a sound and settling nature and only then casting the heat of steel into an ingot or other mould.—*July 14th*, 1927.

MISCELLANEOUS.

273,551. October 25th, 1926.—Improvements in Electrical Earth Connections, Gerald Sydney Holland, of Cumberland Lodge, 65, Wellesley-road, Gunnersbury, London, W. 4.

Ordinary earth plates for earthing electrical systems are liable to corrode, and the object of this invention is to overcome this

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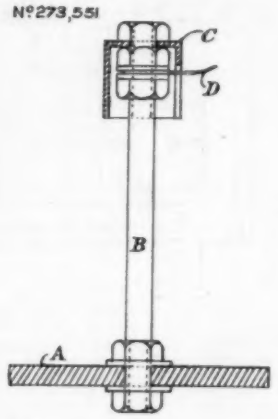
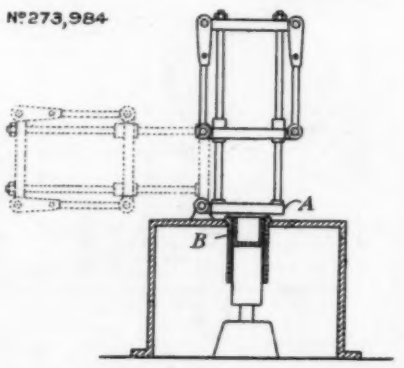


difficulty, and to provide an earth plate that is more porous than the ordinary type of plate. According to the invention, the plate consists of a cellular carbon plate or disc A, which is attached to a metal rod B in the manner shown. A waterproof cap is provided at C, and the connecting wire passes through this cap at the point D.—*July 7th*, 1927.

273,984. February 2nd, 1927.—Casting Metal Under Pressure, M. C. Valls and J. S. Esteller, 18, Angeles, Barcelona, Spain.

This invention is concerned with the application of die casting

No 273,984



principles to moulding with metals of such a high melting temperature that they are liable to adhere to the cooler parts of the machine. The mould is shown at A and may be swung clear of the opening of the press as indicated by the broken lines. Within the top of the press there is placed a receptacle B of asbestos or some such material, into which the molten metal is poured. When the press is operated the receptacle collapses and its contents are forced into the mould without coming into direct contact with the cool parts of the press.—*July 14th*, 1927.

273,993. February 23rd, 1927.—Metallic Packings, The British Metallic Packing Company, Ltd., and G. F. Jones, 7, Princes-street, Westminster.

In this packing the rings are built up of segmental sections of approximately one-third of the circumference each. There are two series of segments for each ring. One series is more or less

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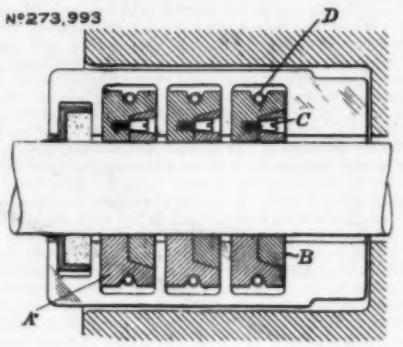

L-shaped as shown at A, while the other series B fits within the recess thus formed. The two sets have their joints staggered and are loosely held together by screws C. The garter springs D have the effect of pressing the segments on to the piston-rod and at the same time making a tight joint against the walls of the stuffing-box axially on account of the conical faces of contact between the two sets of segments.—*July 14th*, 1927.

274,015. June 15th, 1927.—A Device for Lining Pipes with Copper, Dr.-Ing. Siller and Rodenkirchen Gesellschaft mit beschränkter Haftung, of Rodenkirchen-on-Rhine, Germany.

This invention appears to be concerned with the manufacture of surface condenser tubes having a ferrous main body with a copper lining. It is urged that with known processes of pressing

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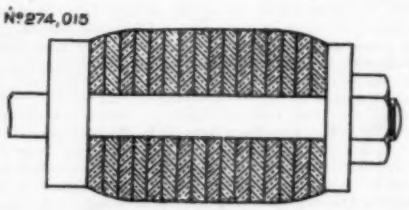

a copper lining into an iron tube there is liability for the contact between the two metals to be insufficiently intimate for heat conduction, while in some parts the copper may be reduced to an undesirable thinness. The inventors consequently force the copper lining into contact with the pipe by means of a mandrel built up of a series of leather discs as shown in the illustration. These discs are able to accommodate themselves to any accidental inequalities in the bore of the pipe.—*July 14th*, 1927.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

SATURDAY, AUGUST 20TH.

North of England Institute of Mining and Mechanical Engineers.—Newcastle-upon-Tyne. Annual general meeting. 2.30 p.m.

WEDNESDAY TO WEDNESDAY, AUGUST 31ST TO SEPTEMBER 7TH.

British Association for the Advancement of Science.—Meetings at Leeds.

TUESDAY TO FRIDAY, SEPTEMBER 6TH TO 9TH.

The Institute of Metals.—Annual meeting at Derby. For programme see page 148.

THURSDAY TO SATURDAY, SEPTEMBER 8TH TO 24TH.

Shipping, Engineering and Machinery Exhibition.—Olympia, London, W. 6.

CONTRACTS.

Blackstone and Co., Ltd., Stamford, have received an order for five "Blackstone" twin-cylinder, spring-injection, cold-starting, heavy fuel oil engines from a customer in the neighbourhood of Paris.

Worthington-Simpson, Ltd., have received from the New South Wales Government an order for the whole of the power plant and pumping machinery required for the new Walsh Island floating dock. The plant will consist of three Worthington-Simpson 360 H.P. solid-injection oil engines, each coupled to 230-kilowatt generators, together with the necessary centrifugal pumping plant, motors and switchgear.

Sir W. G. Armstrong, Whitworth and Co., Ltd., have received an order from the Buenos Aires Great Southern Railway Company for thirty three-cylinder goods type locomotive with double bogie tenders. The locomotives will be constructed at the firm's Scotswood Works, Newcastle-on-Tyne, and will be shipped in fully erected condition on one of the special motor vessels constructed by Armstrong, Whitworth for this purpose. The same company has received an order for twenty-six locomotive boilers for the Bengal Nagpur Railway Company, Ltd. The total value of the two contracts exceeds £250,000.